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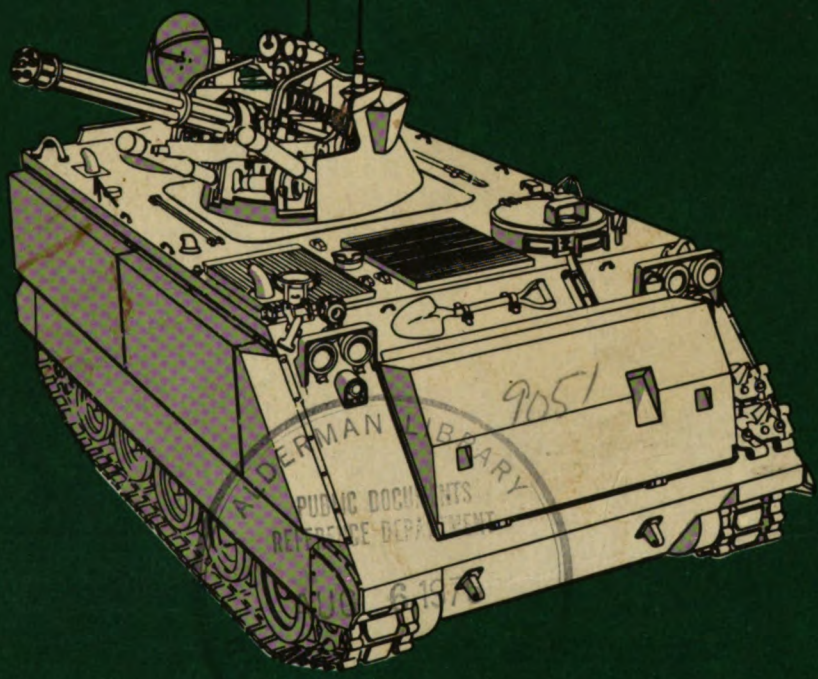
TM 9-2350-300-10

OPERATOR'S MANUAL
(CREW)
FOR
GUN, AIR DEFENSE ARTILLERY, SELF-PROPELLED



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20-MM, M163
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WARNING

M168 CANNON

ALWAYS make sure CANNON IS CLEARED after firing and before servicing. When a cannon stoppage occurs and there is danger of a COOKOFF - take cover and wait for 30 minutes until cannon barrels have cooled before attempting to clear cannon. Always make sure cannon is aimed towards a safe area.

If faulty ammunition is suspected, immediately stop firing and take cover until danger of a HANGFIRE has passed. Make sure cannon is aimed towards a safe area.

WARNING

AMMUNITION

Electrically-primed ammunition can fire if exposed to high-power radio frequency fields. Avoid contact of any kind with the primer, especially metal objects.

Rechambering of live ejected rounds is prohibited. This can result in a HANGFIRE that can cause injury or death of personnel as well as damage to the system.

WARNING

OPERATING VEHICLE

BEFORE LOWERING RAMP, alert everyone in and around vehicle. Make sure RAMP PERSONNEL DOOR IS CLOSED AND LOCKED before operating ramp.

SECURE COMMANDER'S and DRIVER'S hatches with hold-open hooks to prevent injury.

WARNING

WHEN REFUELING the VEHICLE or APU, make a metal-to-metal contact between fuel compartment, or tank, and filling device to prevent static electricity buildup. Observe all safety rules related to fuel handling.

WARNING

M19 INFRARED PERISCOPE

HIGH VOLTAGE is used in this equipment. Death or injury can result if you do not observe safety precautions given in the instructions. ALWAYS connect power cable to periscope before turning ON power. ALWAYS completely deenergize the power pack BEFORE disconnecting the power cable.

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WARNING

CARBON MONOXIDE POISONING CAN KILL YOU

Symptoms of carbon monoxide poisoning are headache, dizziness, loss of muscular control, apparent drowsiness and coma. The following precautions MUST be observed to ensure the safety of the crew.

1. DON'T operate heater or engine in an enclosed area unless ADEQUATELY VENTILATED.
2. DON'T idle engine without maintaining ADEQUATE VENTILATION in vehicle.
3. DON'T drive vehicle with inspection plates, cover plates, or engine access panel and doors removed.
4. BE ALERT for exhaust odors and exposure symptoms. If either are present, IMMEDIATELY VENTILATE vehicle. If symptoms persist, remove affected personnel from vehicle and treat as follows: expose to fresh air; keep warm; DON'T PERMIT PHYSICAL EXERCISE; if necessary, administer artificial respiration.

WARNING

DANGEROUS VOLTAGE

HIGH VOLTAGE is used in this system. Death or Injury can result if you do not observe the safety precautions given in the instructions.

LOW VOLTAGE can also be dangerous. DON'T be mislead by this term. Potentials as low as 50 volts may cause death under certain circumstances.

WARNING

AN/VPS-2 RADAR SET

HIGH VOLTAGE is present in the receiver-transmitter (unit 2) when the panel assembly is opened for servicing and the power is on. Be careful when changing radar frequency.

A potential RADIATION hazard exists when radar is energized and transmitting. Stay at least 3 feet away from center of radar antenna when radar is transmitting.

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Technical Manual

No. 9-2350-300-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 28 May 1976

OPERATORS MANUAL (CREW)
GUN, AIR DEFENSE ARTILLERY SELF-PROPELLED 20-MM, M163

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* This manual supersedes TM 9-2350-300-10, 10 March 1971, including all changes.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. This manual provides crew operating and maintenance instructions for the M163, self-propelled Vulcan system. Use it to maintain your proficiency, and keep your M163 in peak condition. A look at the table of contents will show you the scope of this manual.

Section II. DESCRIPTION AND DATA

1-2. Description. The M163 20MM self-propelled air defense gun is a lightweight, full-tracked weapon. It provides close-in defense against low-flying aircraft and ground targets; has a high degree of mobility, and is air-transportable. It is also capable of amphibious operation on streams and small lakes. The major components of the M163 are the M741 tracked chassis, the M168 20MM cannon, the M61 sight, the M157 mount, and the AN/VPS-2 radar set. Additional details of the M163 are shown on pages 1-3 and 1-4. If you want more information on components, ask your organizational maintenance for a copy of TM 9-2350-300-20.

1-3. Tabulated Data

WEIGHTS AND DIMENSIONS

Combat loaded weight	11203.7 Kg (24,700 lbs)
Overall length	436.5 cm (14 ft, 4 in.)
Overall width	286.8 cm (9 ft, 5 in.)
Overall height	291.9 cm (9 ft, 7 in.)

PERFORMANCE

Firing rate-shots per minute	
High rate	3000 spm
Low rate	1000 spm
Burst limits - high rate only	10, 30, 60 or 100 rds
Maximum trench width	152.2 cm (5 ft)
Minimum turning radius	395.9 cm (13 ft)
Maximum speed, forward	64.4 KPH (40 mph)
Maximum speed, reverse	14.5 KPH (9 mph)
Maximum grade	60 pct
Cruising range	442.6 K (275 miles)
Maximum speed in water, forward only	6.4 KPH (4 mph)
Freeboard, combat loaded	279.4 MM (11 in.)

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SECTION II. DESCRIPTION AND DATA – CONTINUED

COMPONENT CAPACITIES	REFILL	DRY
Fuel, diesel	359.6 L (95 gals)	359.6 L (95 gals)
Engine, oil	7.57 L (8 qts)	20.8 L (22 qts)
Engine, cooling system	37.84 L (40 qts)	37.84 L (40 qts)

RADAR (RANGE)

Minimum	250 meters
Maximum	5000 meters (1 sq meter target)

Nomenclature Cross Reference

Common Name	Official Nomenclature
Stow Control	Radar Distribution Box (unit 6)
Distribution Box	System Distribution Box
Cannon	Air Defense Gun Cannon (M168)
Auxiliary Power Unit (APU)	Generator Set, Gasoline Engine
CVC Helmet	Combat Vehicle Communications Helmet
Elliptical Muzzle Clamp (6 x 18 mil)	Air Defense Muzzle Clamp
Circular Muzzle Clamp (5 mil)	Ground Role Muzzle Clamp

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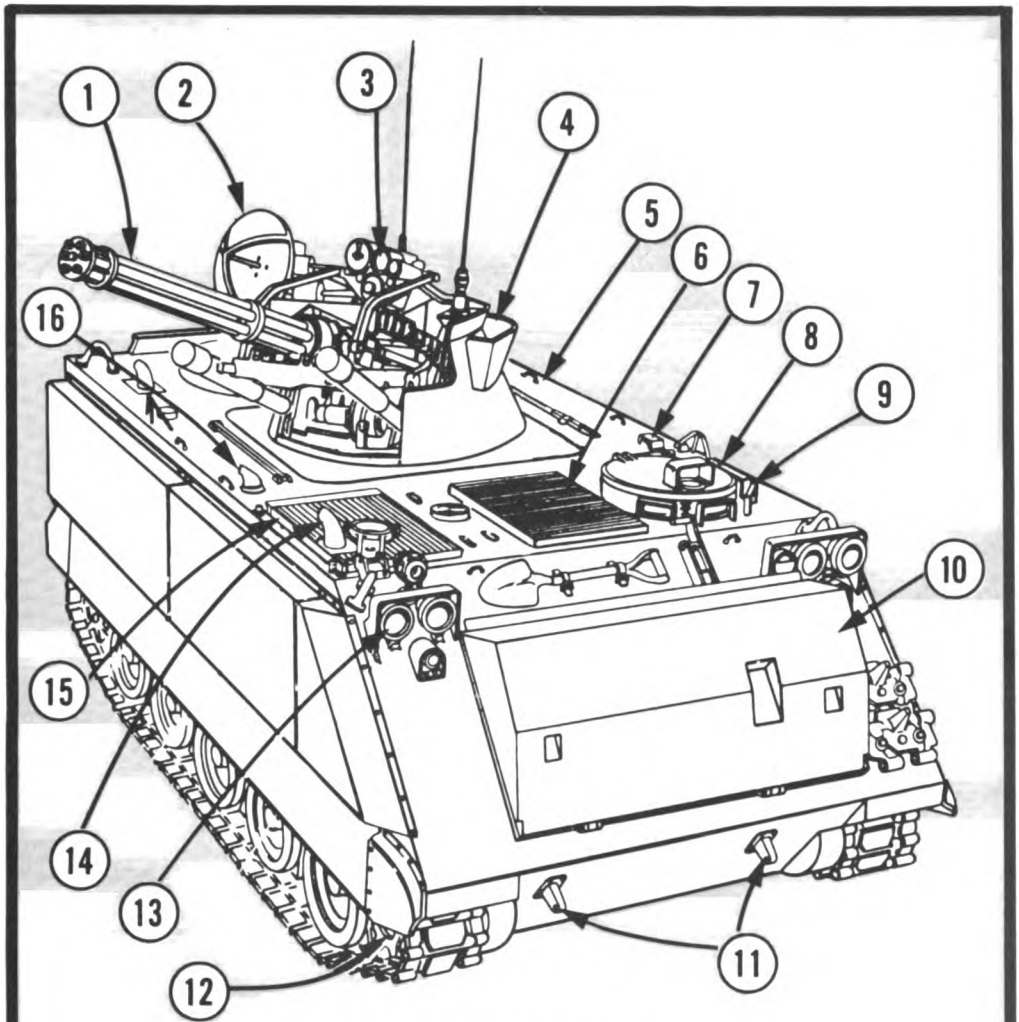
M163 GUN SYSTEM



RIGHT FRONT VIEW

1. 20mm cannon M168
2. Radar antenna (Unit 1)
3. Sight M61
4. Mount M157
5. Chassis M741
6. Air intake grill
7. Fire extinguisher handle
8. Driver's hatch
9. Periscope M17
10. Trim vane
11. Towing eyes
12. Drive sprocket
13. Lights
14. Engine exhaust
15. Exhaust grill
16. Heater exhaust

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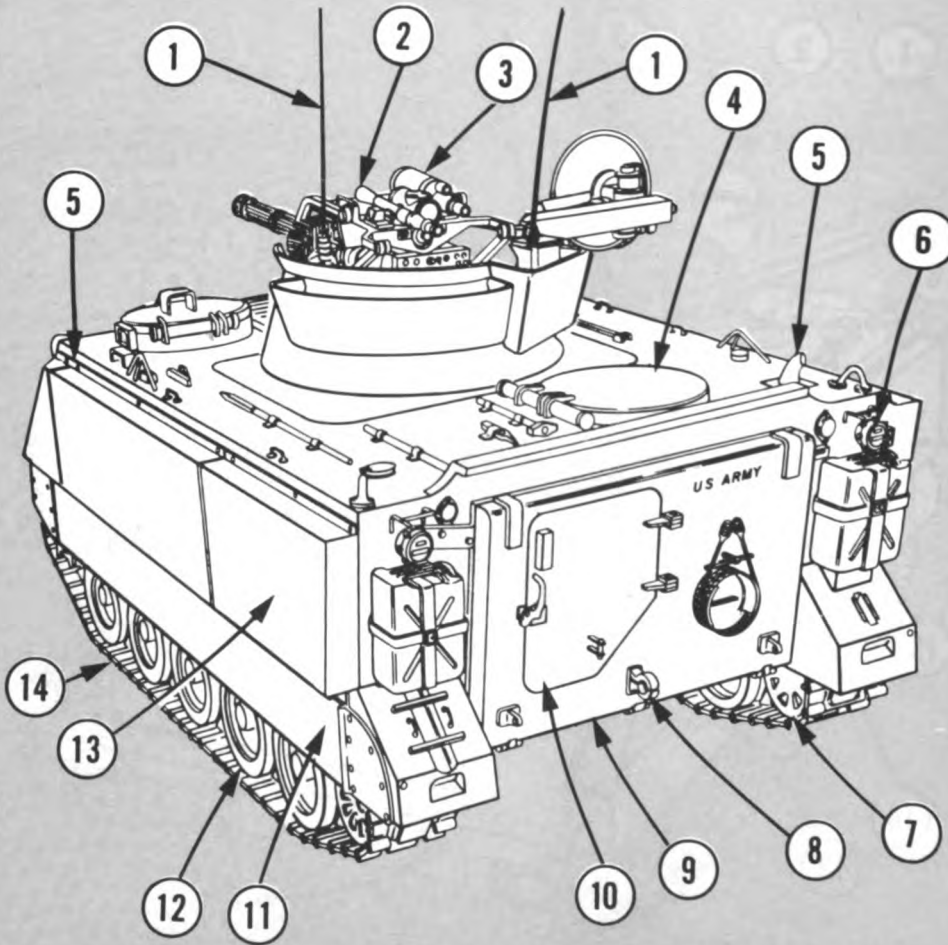
M163 GUN SYSTEM



LEFT REAR VIEW

1. Radio antennas
2. Telescope M134
3. Night sight AN/TVS-2B
4. Commander's hatch
5. Bilge outlet
6. Rear light
7. Idler wheel
8. Towing pintle
9. Ramp
10. Personnel door
11. Track shroud
12. Road wheel
13. Flotation pod
14. Track

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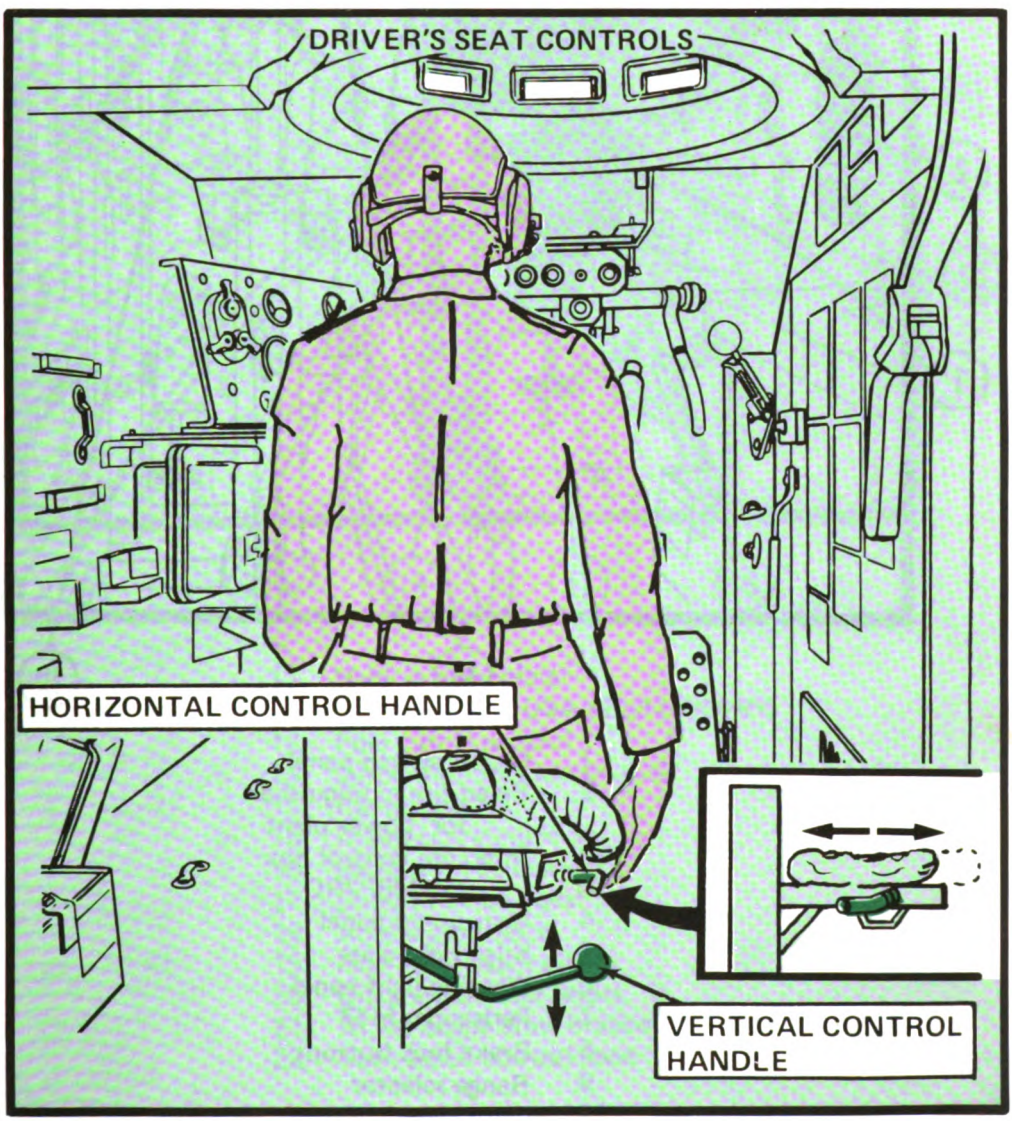
CHAPTER 2
OPERATING INSTRUCTIONS

Section I.
M163 CONTROLS, INSTRUMENTS AND INDICATORS

2-1. KNOW YOUR CONTROLS AND INSTRUMENTS. Before you attempt to operate your equipment make certain that you are familiar with the location and operation of all controls and instruments.

DRIVER'S COMPARTMENT



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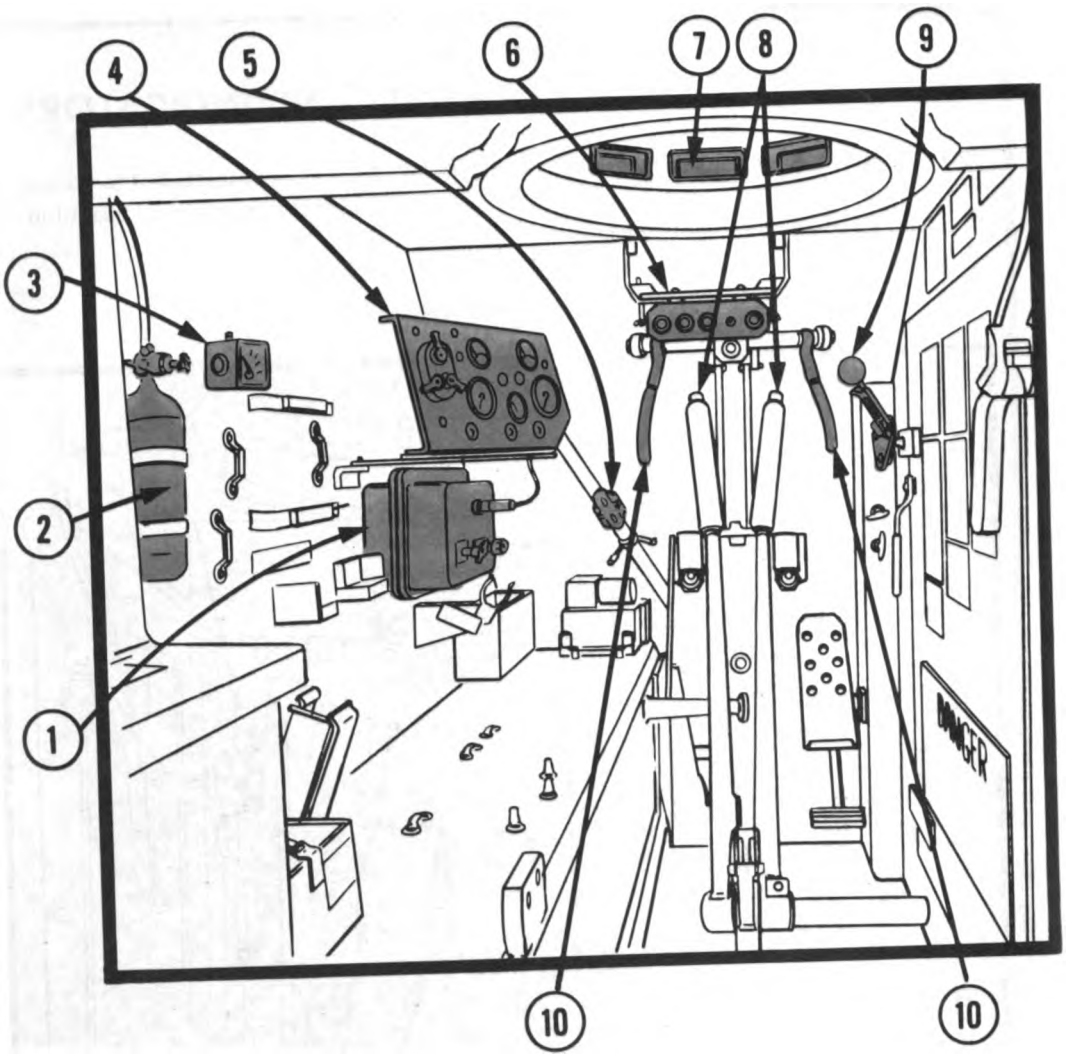
DRIVER'S COMPARTMENT – CONTINUED



1. Master switch panel
2. Fixed fire extinguisher for power plant
3. Intercom control box C-2298/VRC
4. Instrument panel
5. Bilge sight glass
6. Warning light panel
7. Periscopes M17
8. Brake lock buttons
9. Range selector
10. Pivot steer levers

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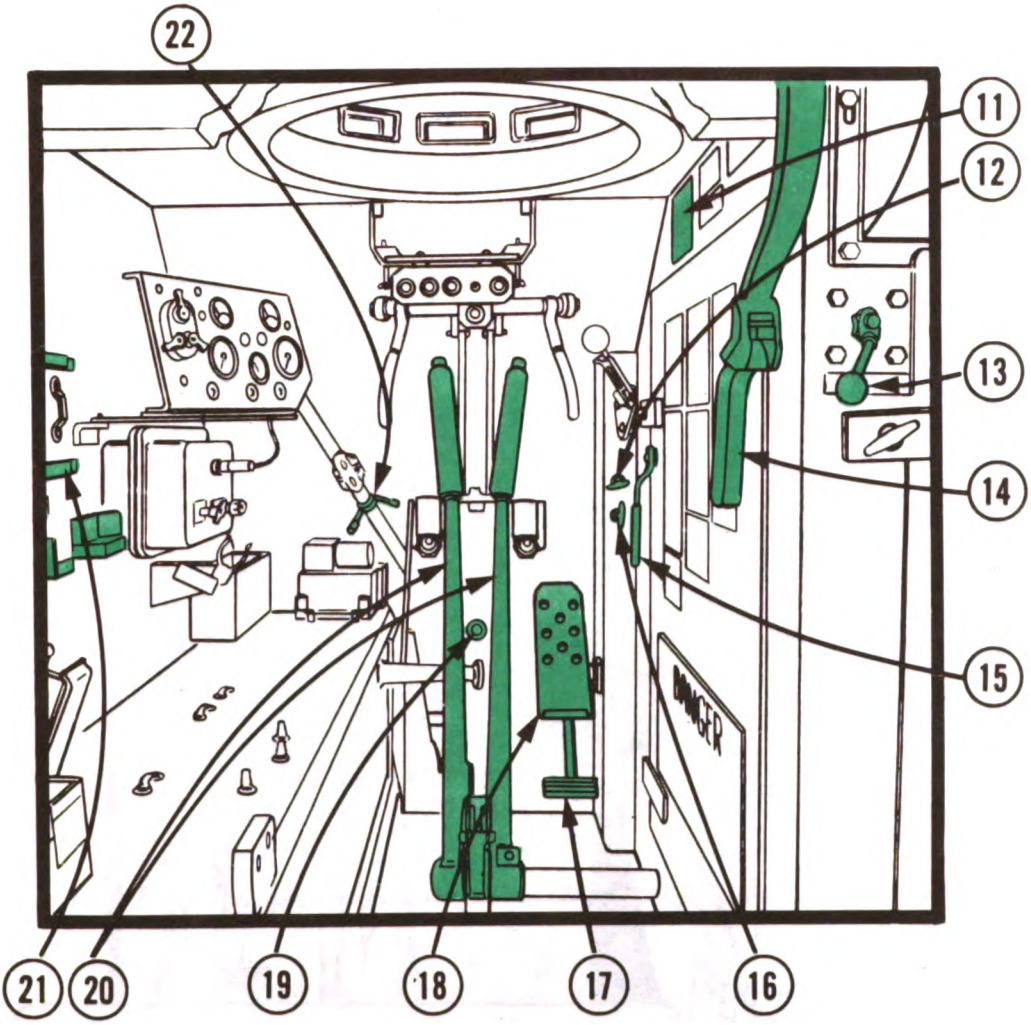
DRIVER'S COMPARTMENT – CONTINUED



11. Vehicle nameplate (vehicle and USA serial numbers)
12. Fuel cutoff control
13. Suspension lockout control
14. Ramp lock
15. Ramp actuating lever
16. Hand throttle control
17. Detent release pedal
18. Accelerator pedal
19. High-Low beam switch
20. Differential steer levers
21. IR Periscope stow bracket
22. Turn signal control lever

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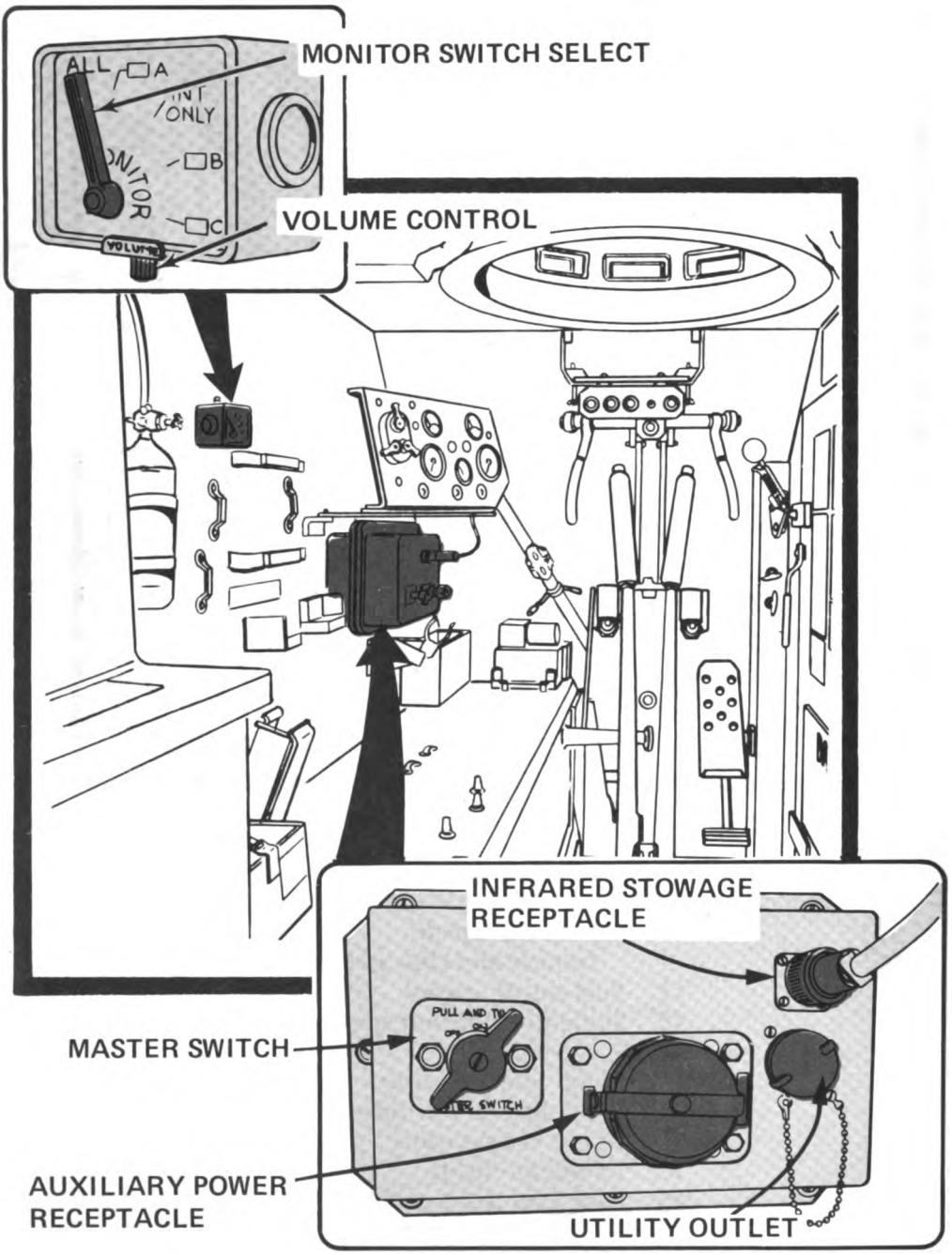
DRIVER'S COMPARTMENT – CONTINUED



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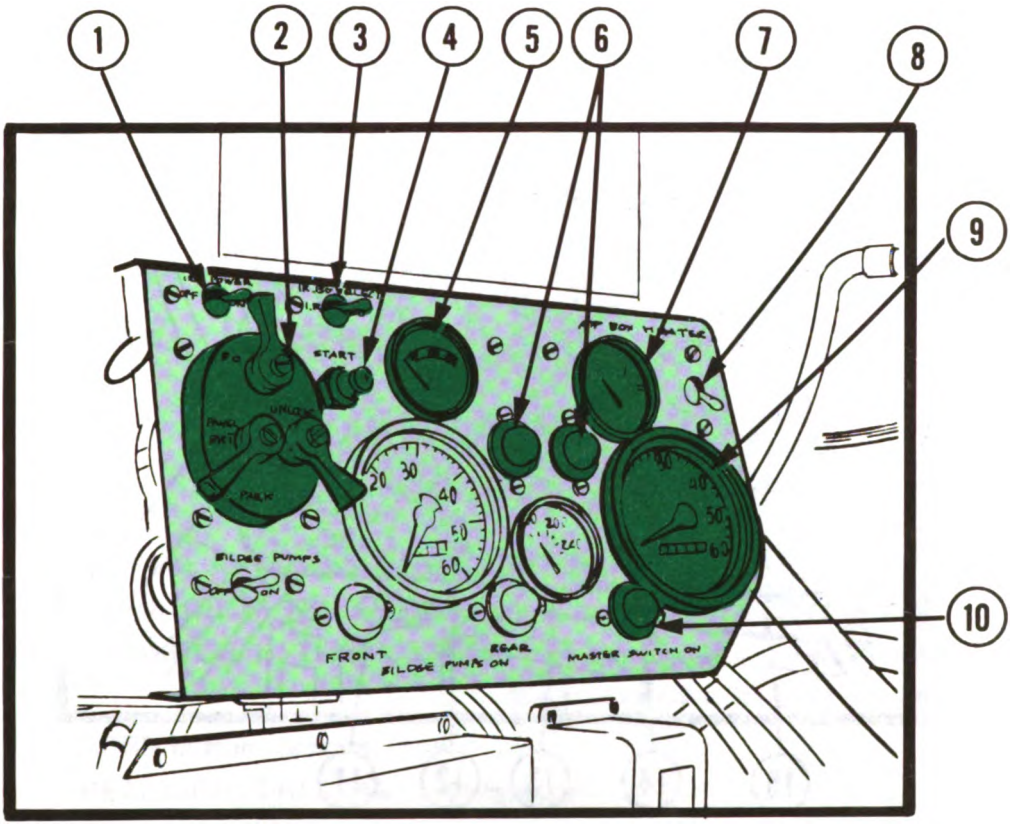

1. I.R. POWER switch - Turns on power to M19 periscope.
2. Lights switch assembly
3. I.R. – B.O. SELECT
4. START pushbutton switch – energizes engine starter.
5. BATTERY–GENERATOR meter–battery and generator voltage.
6. Panel lights – illuminates instrument panel.
7. FUEL indicator – amount of fuel in tank.
8. AIR BOX HEATER switch – turns on air box heater for cold weather starting; switch spring loaded to off.
9. SPEEDOMETER; speed in miles per hour.
   Odometer; miles traveled.
10. MASTER SWITCH ON indicator – when lit, master switch is set to on – or APU is being used to charge chassis batteries.

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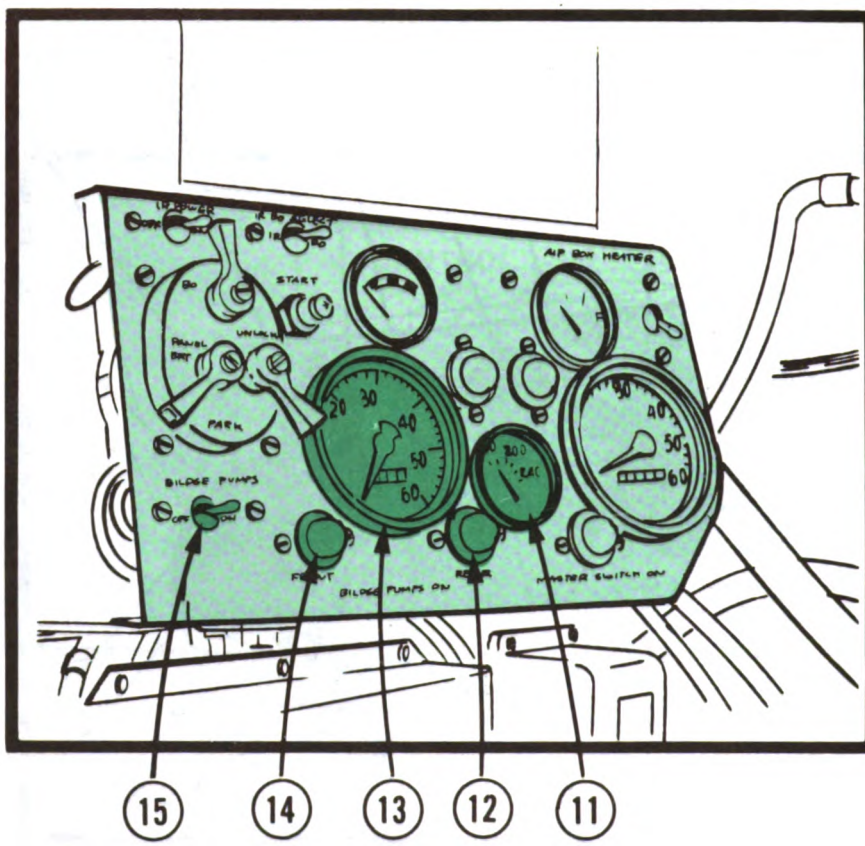
DRIVER'S COMPARTMENT – CONTINUED



11. Engine TEMP F—engine temperature in degrees fahrenheit.
12. REAR indicator—rear bilge pump on.
13. TACHOMETER—engine speed in RPM.
14. FRONT indicator—front bilge pump on.
15. BILGE PUMPS switch—turns on front and rear bilge pumps.

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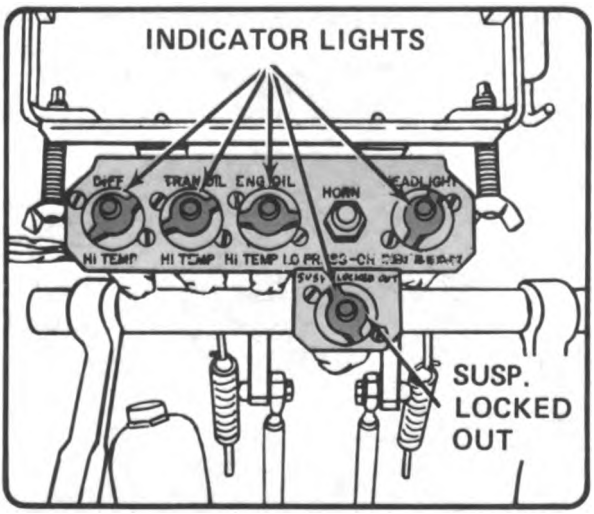
DRIVER'S COMPARTMENT – CONTINUED

WARNING LIGHTS PANEL



DIFF OIL HI TEMP—temperature of differential oil too high.

TRANS OIL HI TEMP—temperature of transmission oil too high.

ENGINE OIL HI TEMP LO PRESS—temperature of oil too high or oil pressure too low (lit when using APU).

HORN button—operates horn.

HEADLIGHTS HI BEAM—high beam on.

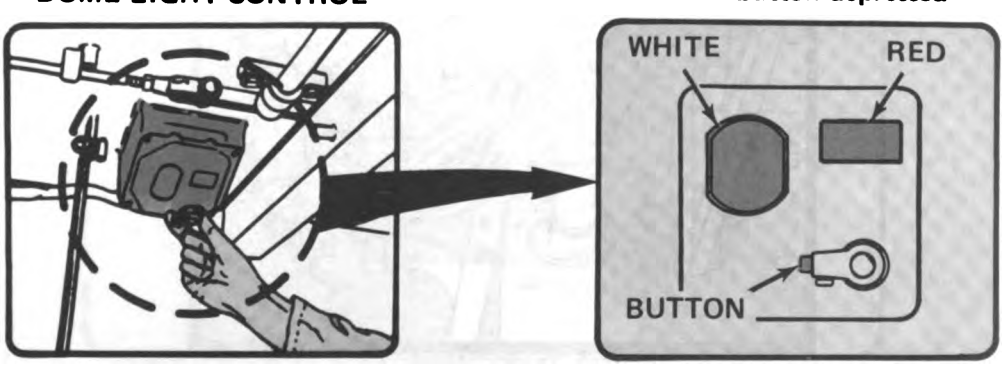
SUSP LOCKED OUT—suspension system locked out.

RED LIGHT—turn fully clockwise

OFF—center position

WHITE LIGHT—turn fully counter-clockwise with button depressed

DOME LIGHT CONTROL



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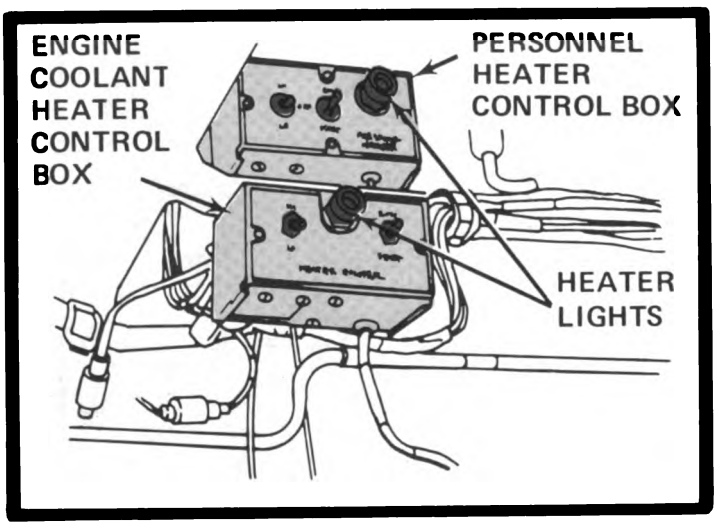
DRIVER'S COMPARTMENT – CONTINUED

PERSONNEL AND COOLANT HEATER CONTROL BOXES

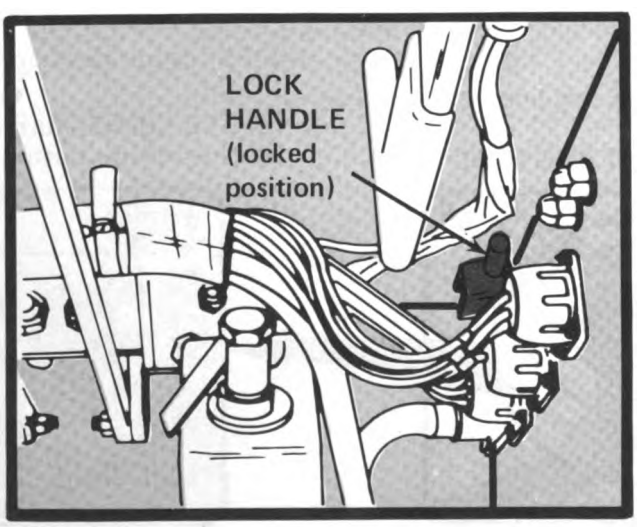


HI/LO switches - regulate temperature
START/OFF/RUN switches

START – spring loaded to OFF from START
RUN – runs heater

Heater lights – heater running when lit.
Rotate lens cover clockwise – light dims.
Rotate lens cover counterclockwise – light brightens.
Push in on lens cover – light indicates voltage at box.

ENGINE ACCESS DOOR INTERIOR COMBAT LOCK HANDLE



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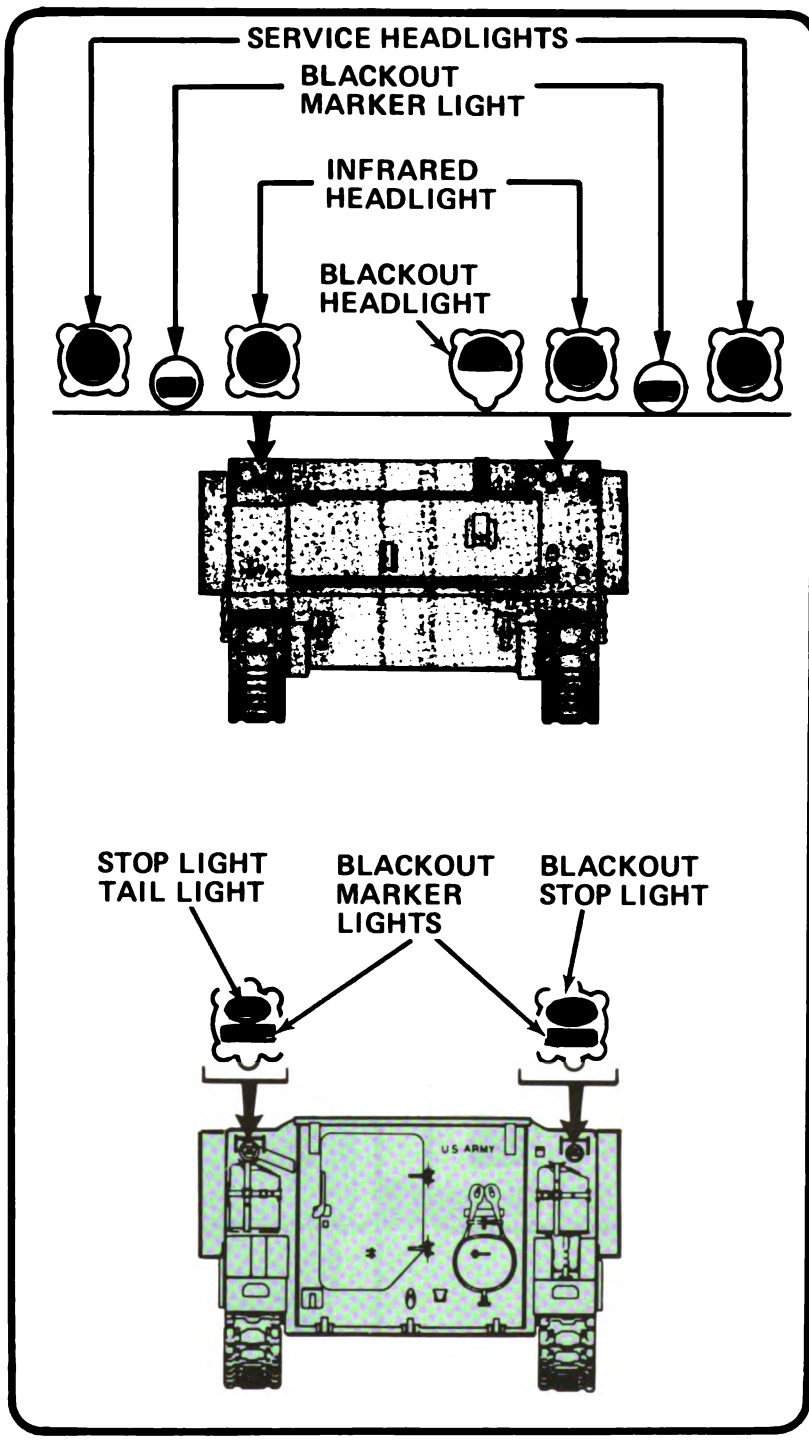
LIGHTS

EXTERNAL LIGHTS



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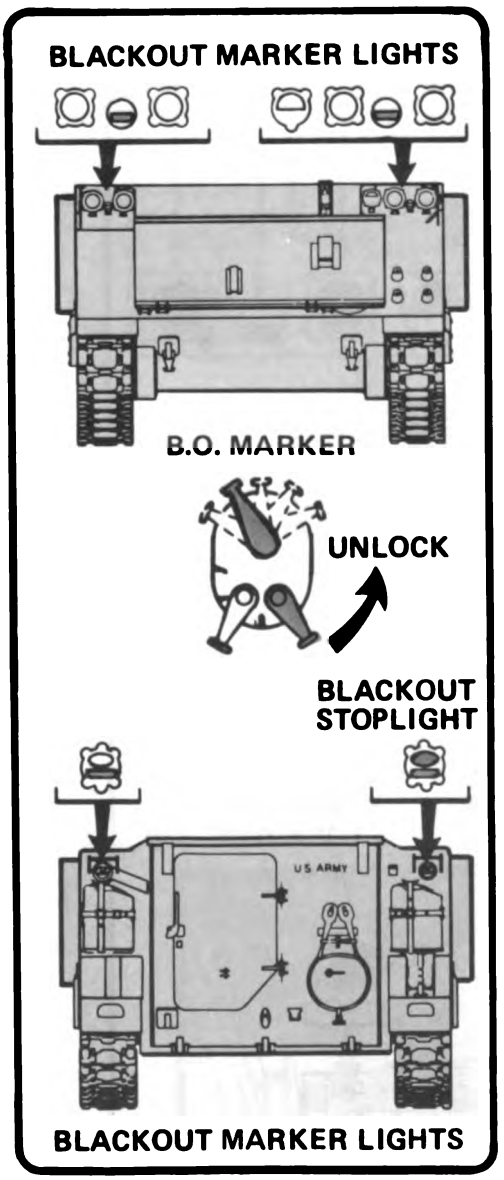
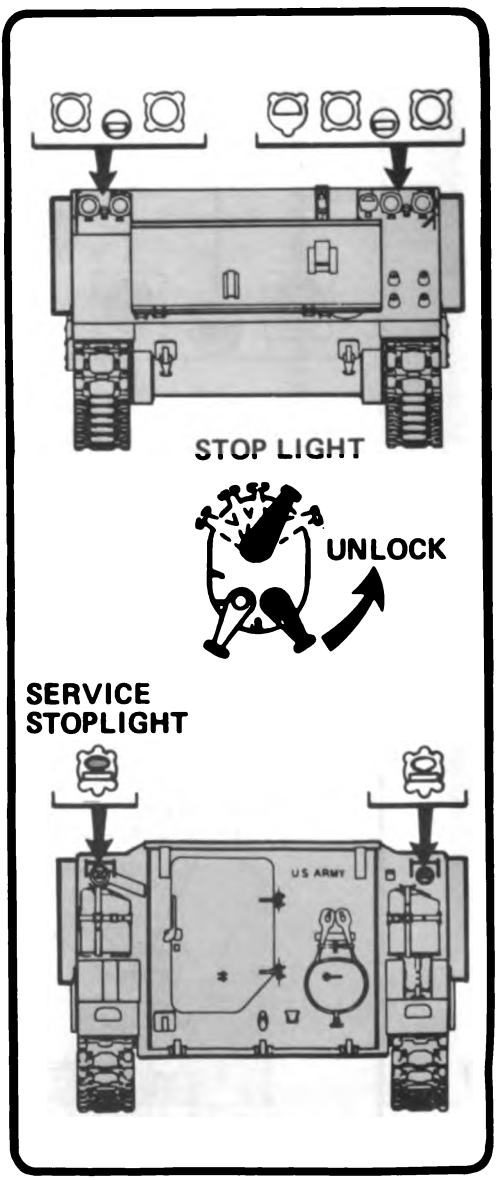
LIGHTS – CONTINUED

LIGHT SWITCHES





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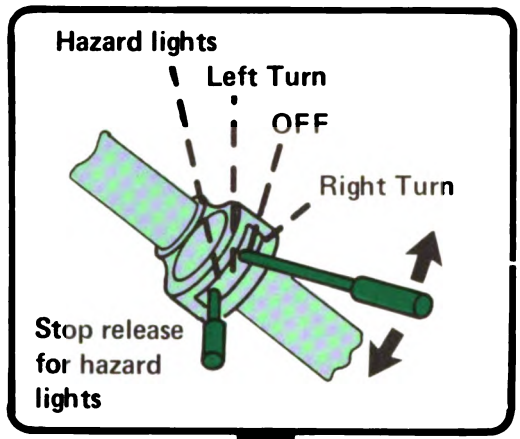
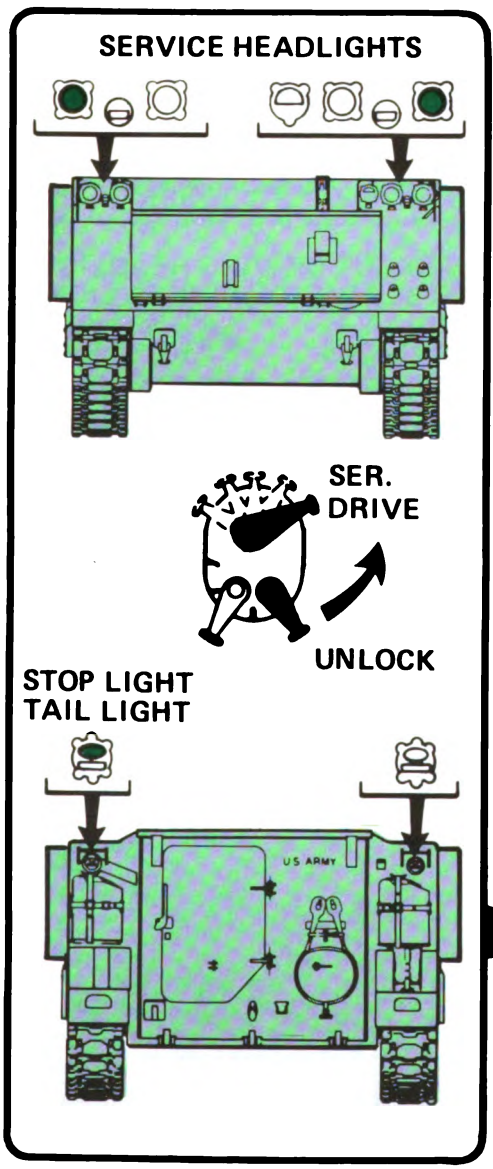
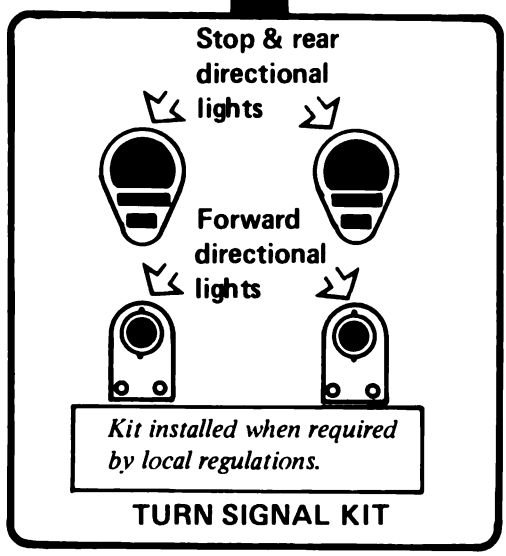
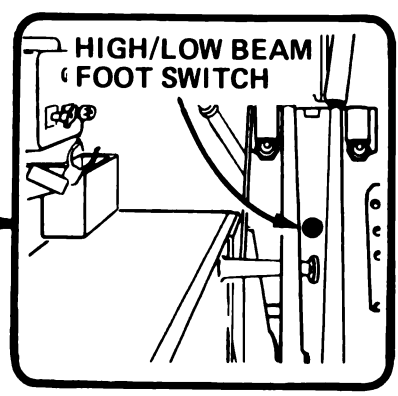
LIGHTS – CONTINUED

LIGHT SWITCHES









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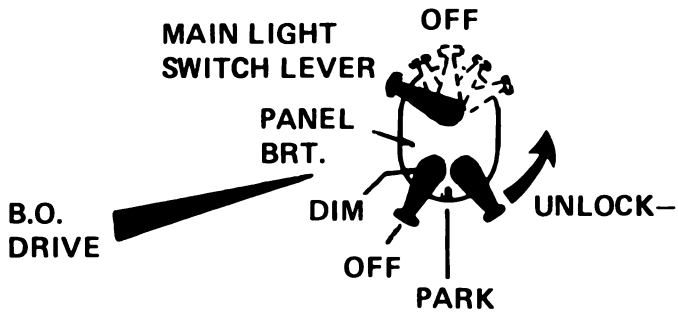
LIGHTS – CONTINUED

INSTRUMENT PANEL/LIGHT/I.R. - B.O. SWITCHES

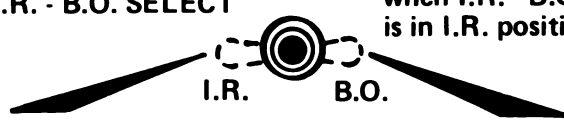


spring loaded switch momentarily unlocks main and panel light switches

NOTE

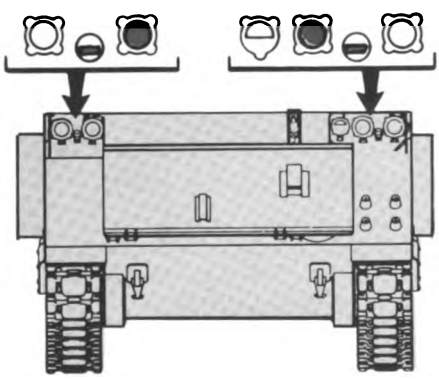
M-19 PERISCOPE must be used when I.R. - B.O. SELECT switch is in I.R. position

I.R. - B.O. SELECT



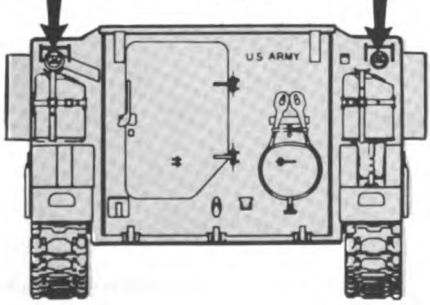
I.R.

INFRARED HEADLIGHTS AND BLACKOUT MARKER LIGHT



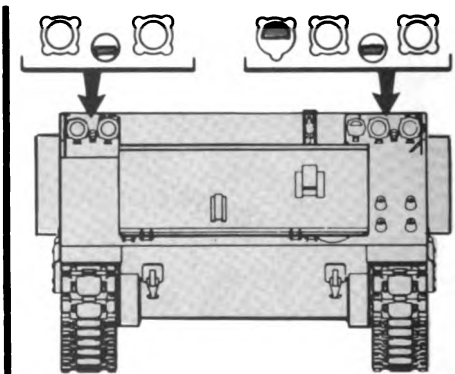
BLACKOUT MARKER LIGHTS

BLACKOUT STOP LIGHT



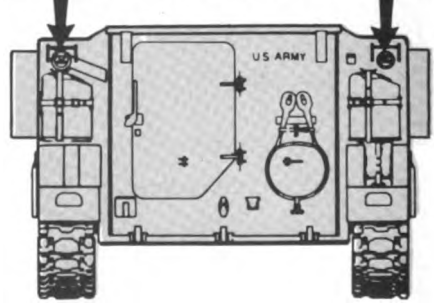
B.O.

BLACKOUT DRIVING HEADLIGHT AND BLACKOUT MARKER LIGHTS



BLACKOUT MARKER LIGHT

BLACKOUT STOP LIGHT



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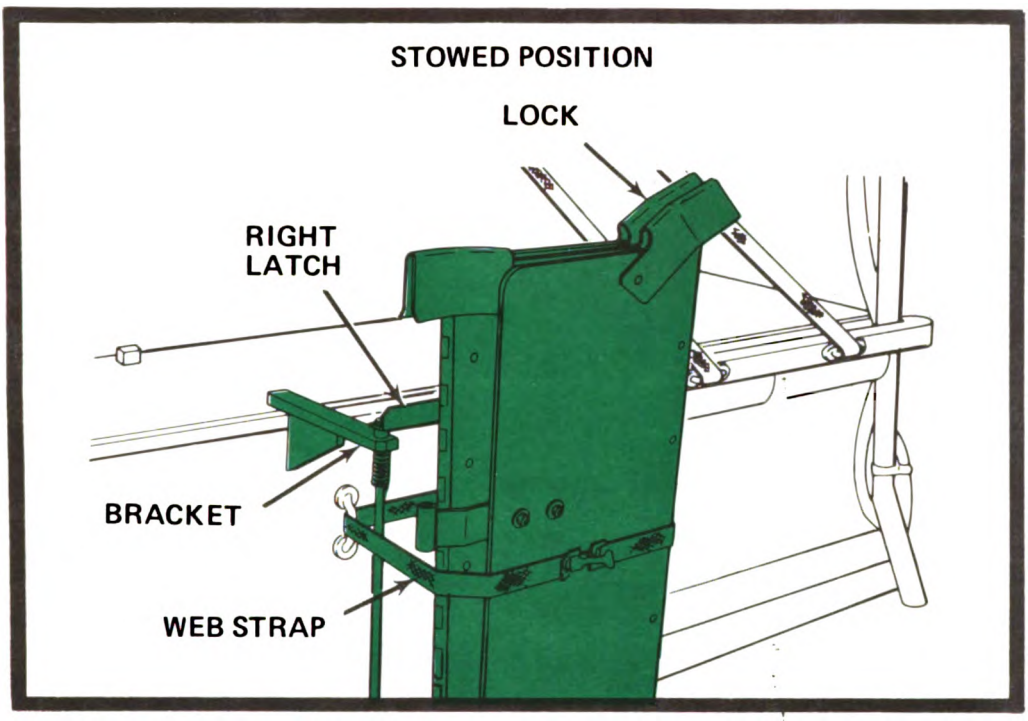
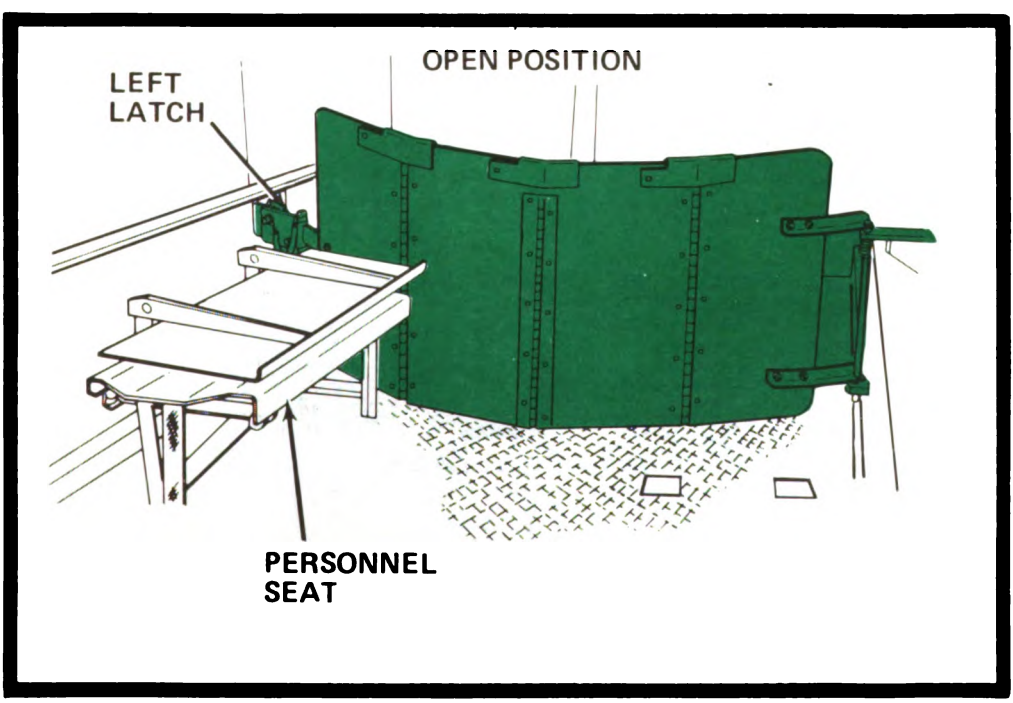
CREW COMPARTMENT

TURRET SAFETY GUARD





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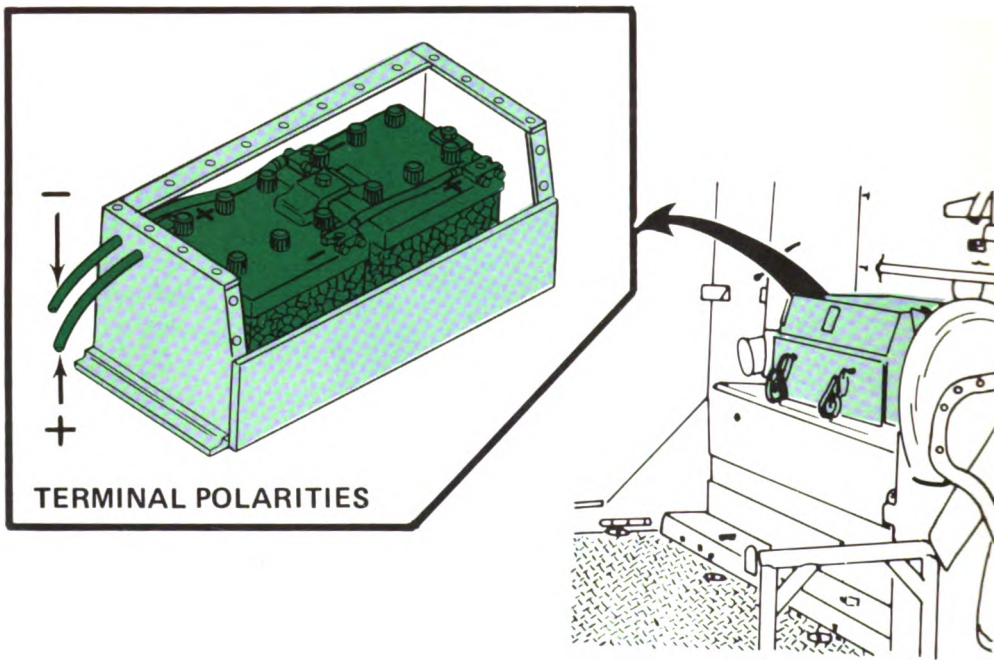
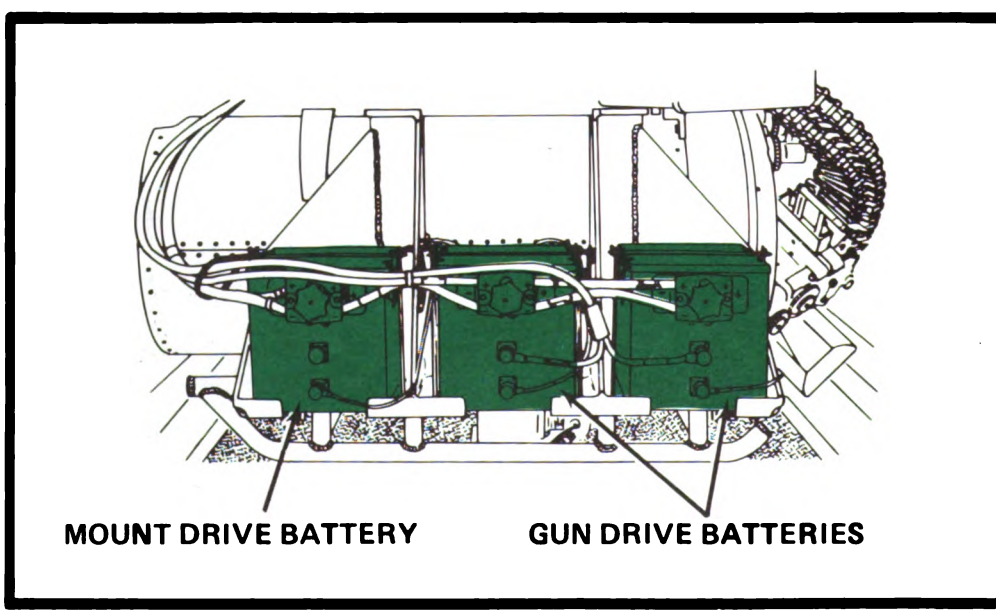
CREW COMPARTMENT—CONTINUED

CHASSIS BATTERIES



GUN SYSTEM BATTERIES



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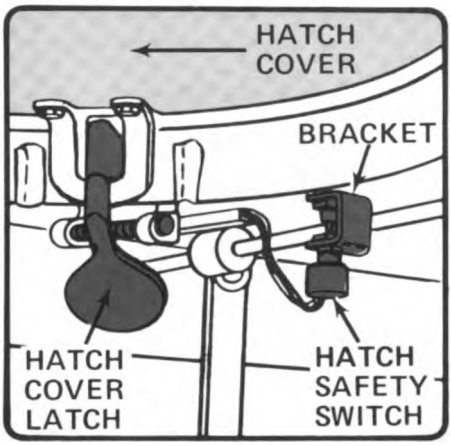
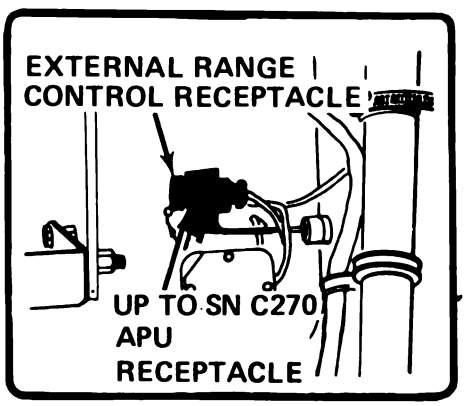
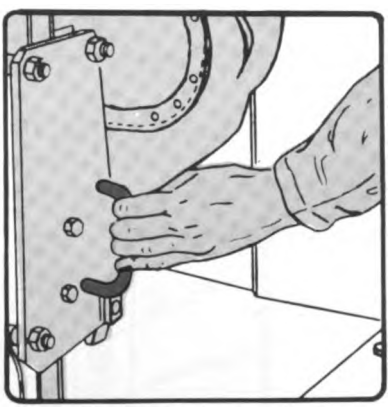
CREW COMPARTMENT – CONTINUED

COMMANDER'S HATCH

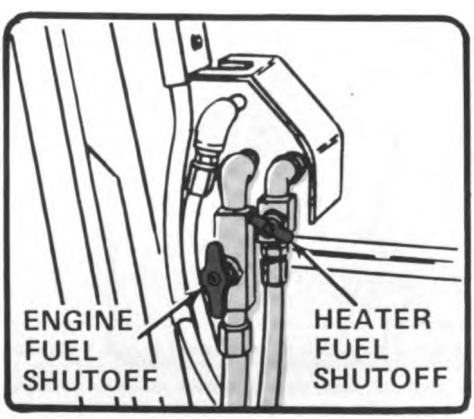




COMMANDER'S SEAT CONTROLS



SEAT RELEASE HANDLE



VERTICAL CONTROL HANDLE

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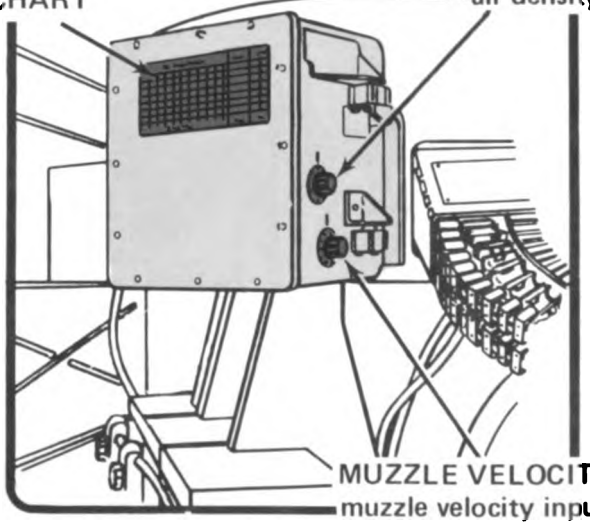
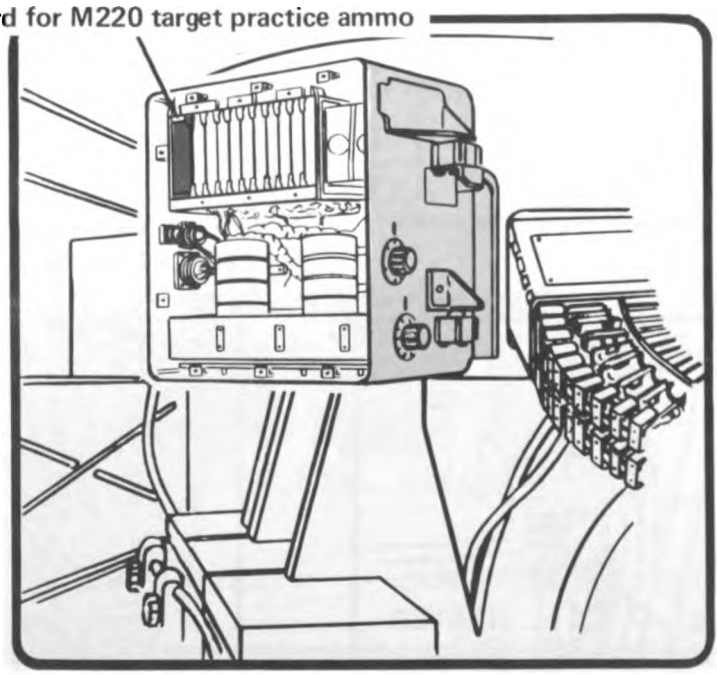
CREW COMPARTMENT – CONTINUED

SIGHT CURRENT GENERATOR



BALLISTIC CORRECTION CIRCUIT CARD A12 -

One side for M246 tactical ammo.
Reverse card for M220 target practice ammo



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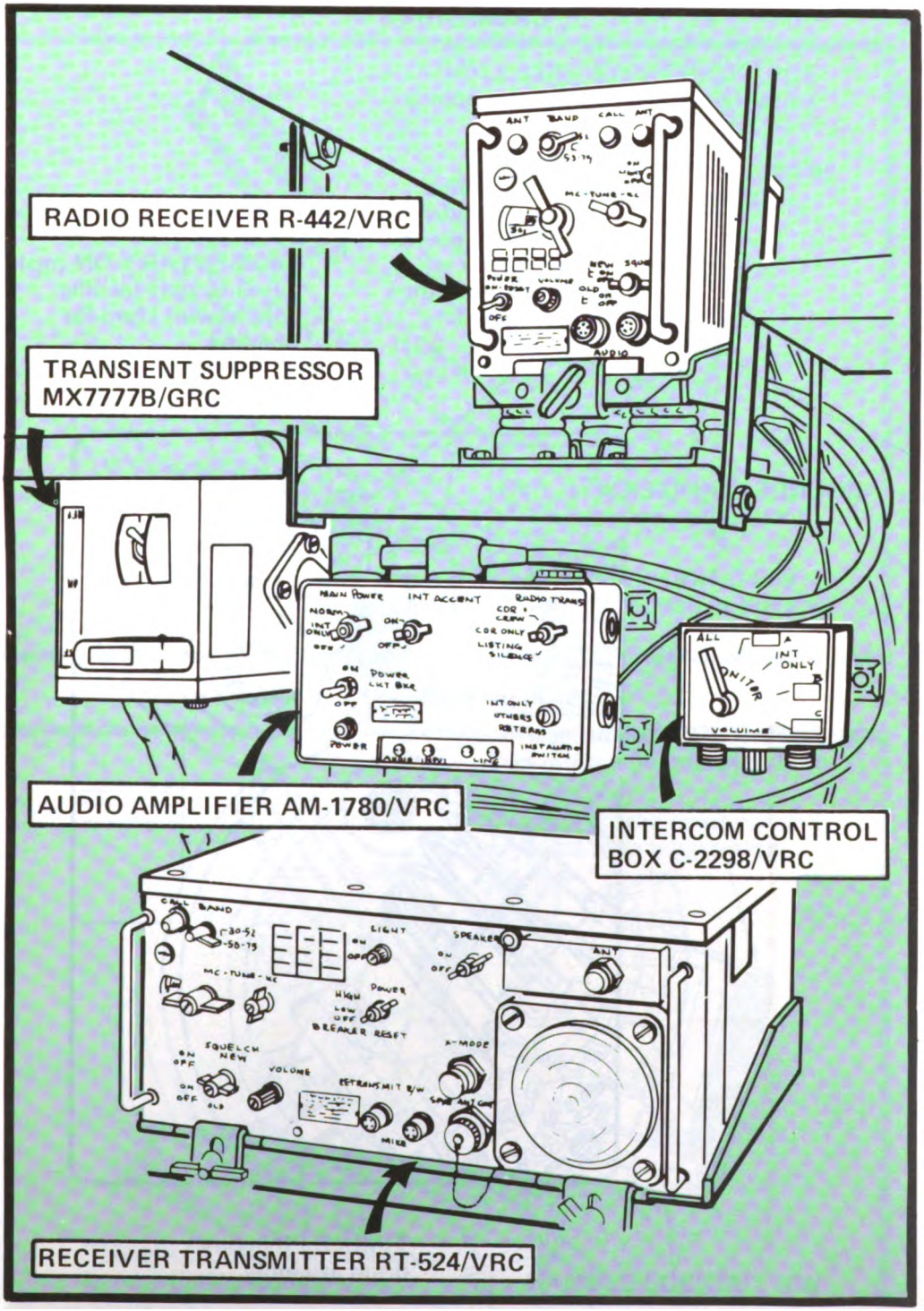
CREW COMPARTMENT—CONTINUED

RADIO SET AN/VRC-47



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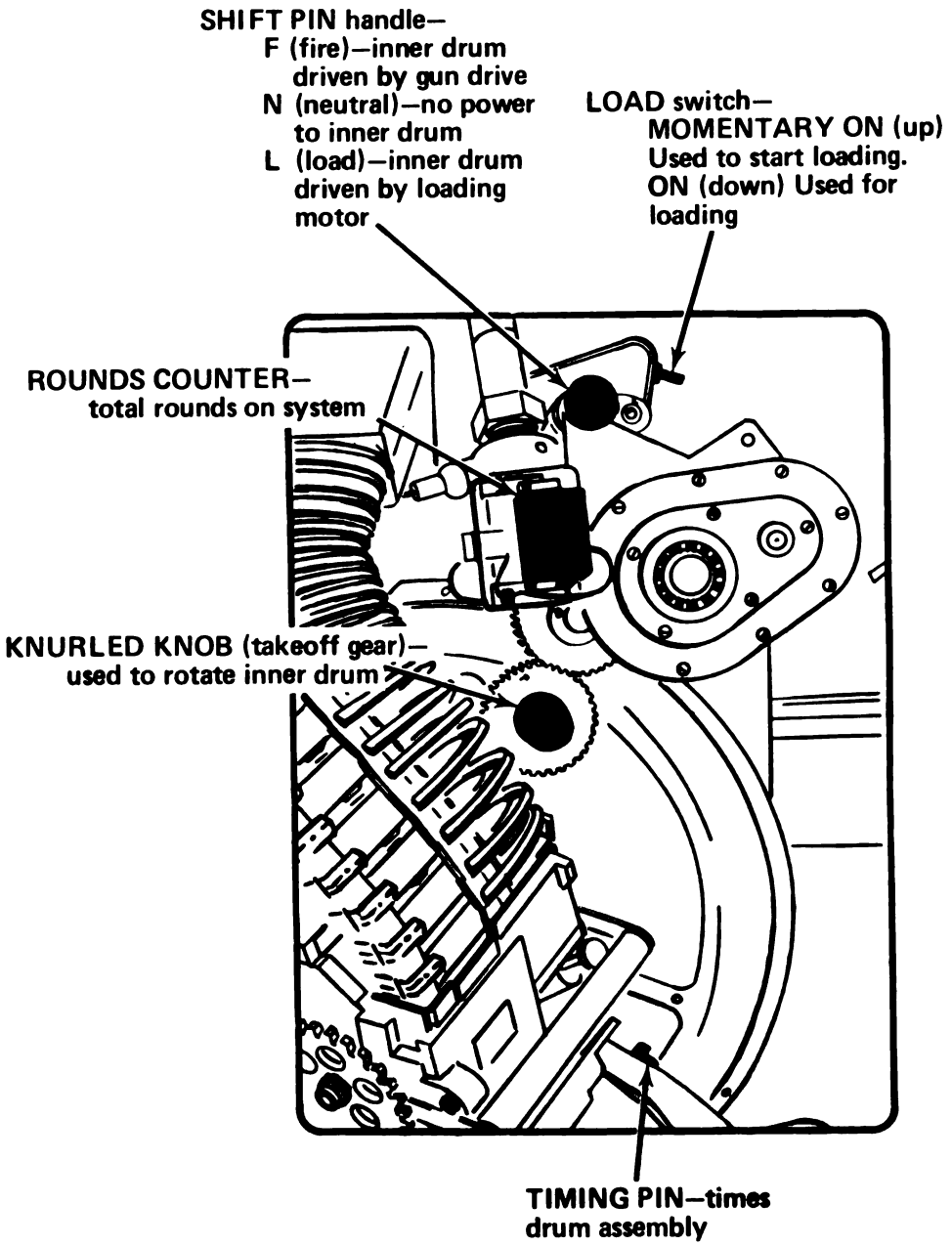
CREW COMPARTMENT – CONTINUED

DRUM DRIVE



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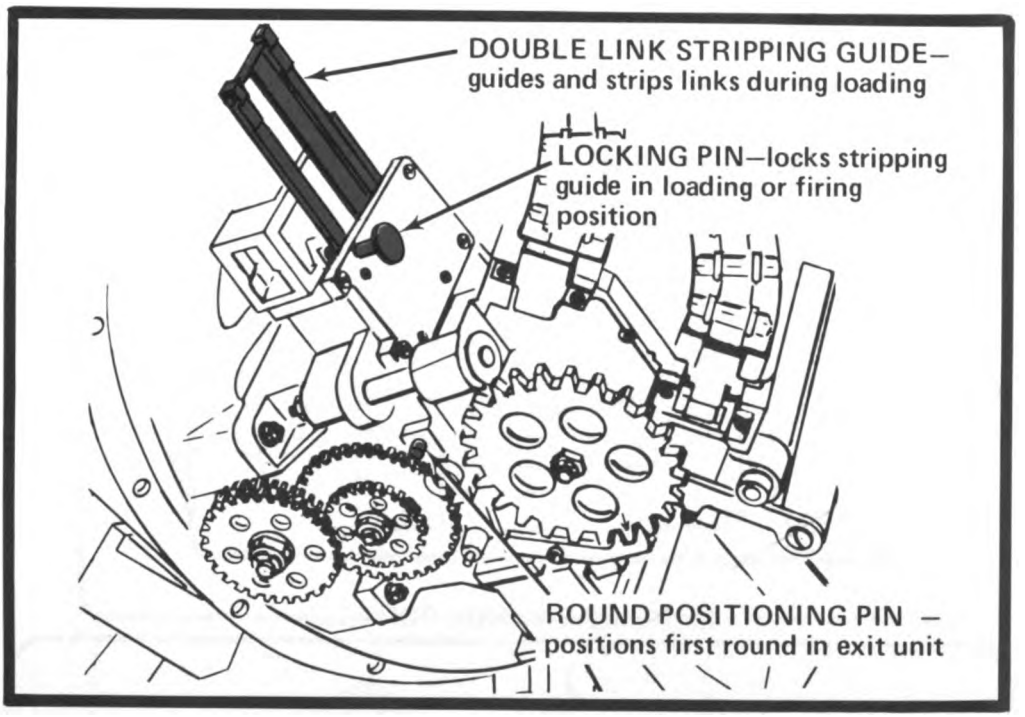
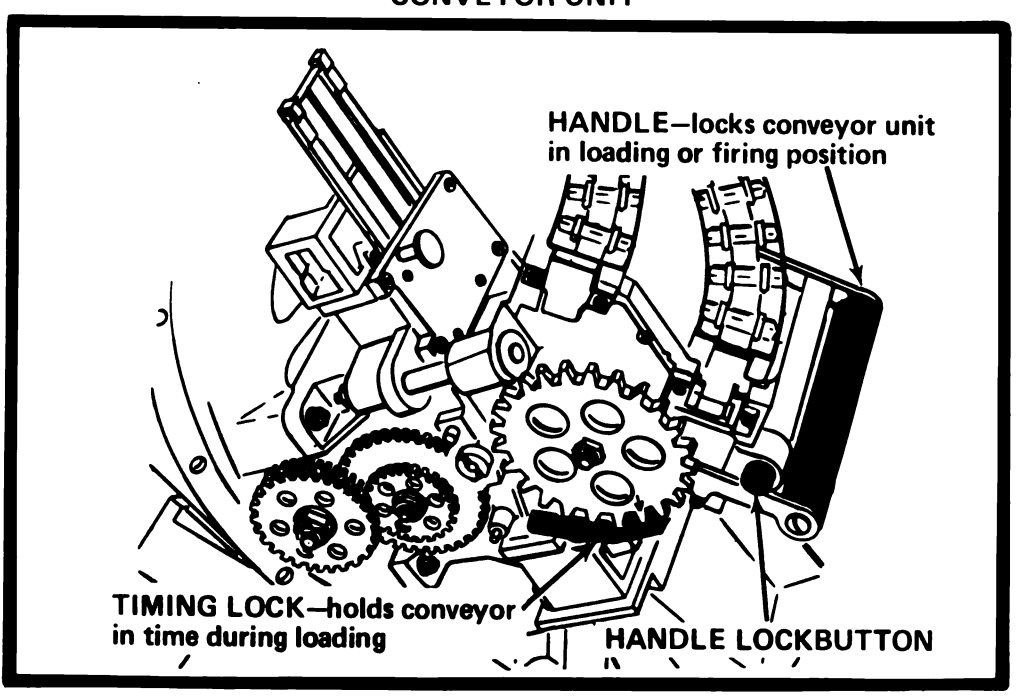
CREW COMPARTMENT – CONTINUED

EXIT UNIT



CONVEYOR UNIT



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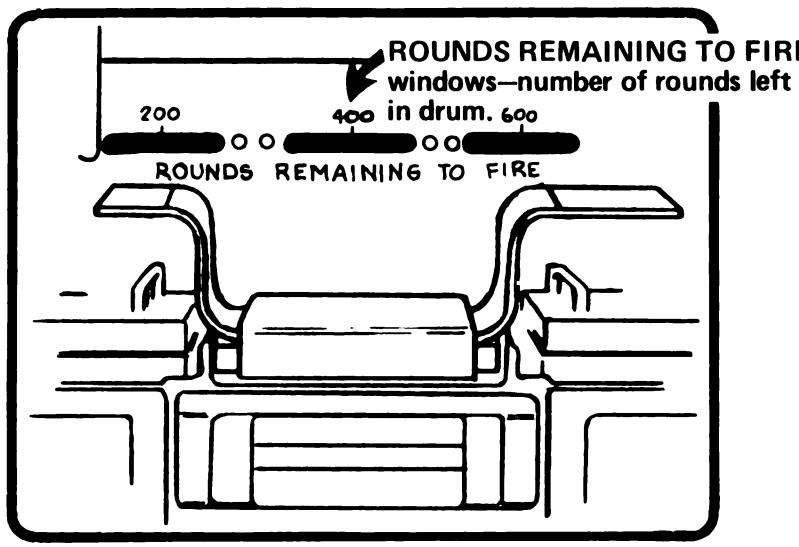
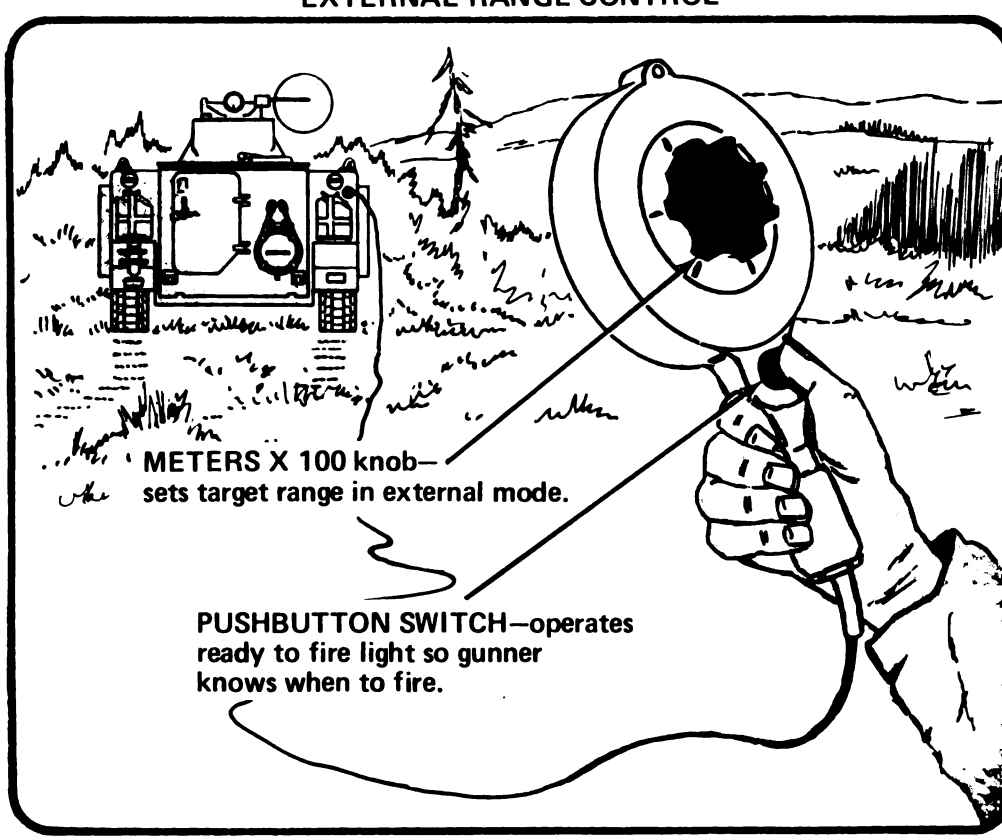
CREW COMPARTMENT – CONTINUED

OUTER DRUM CONTROLS



EXTERNAL RANGE CONTROL



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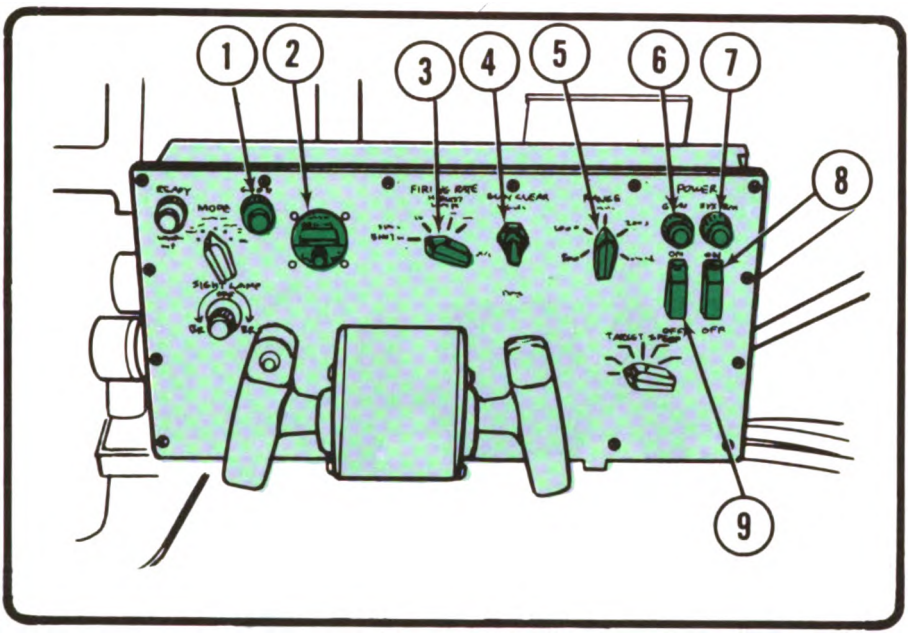
MOUNT

CONTROL ASSEMBLY



1. GOOD WHEN LIT indicator—Prefire check test indicator.
2. ROUNDS REMAINING counter-rounds remaining in ammo drum.
3. FIRING RATE switch—
   LO-NO BURST LIMIT
   HI-BURST LIMIT— 10 rounds
   — 30 rounds
   — 60 rounds
   —100 rounds
4. GUN CLEAR switch—
   AUTO—cannon clears automatically
   OPERATOR—cannon cleared by holding switch
   OFF—cannon does not clear after firing
5. RANGE knob—Set estimated range in MAN mode.
6. GUN POWER indicator—lights when power is applied to firing circuits.
7. SYSTEM POWER indicator—lights when power is applied to system.
8. SYSTEM POWER switch—applies power to system.
9. GUN POWER switch—applies power to cannon firing circuits.

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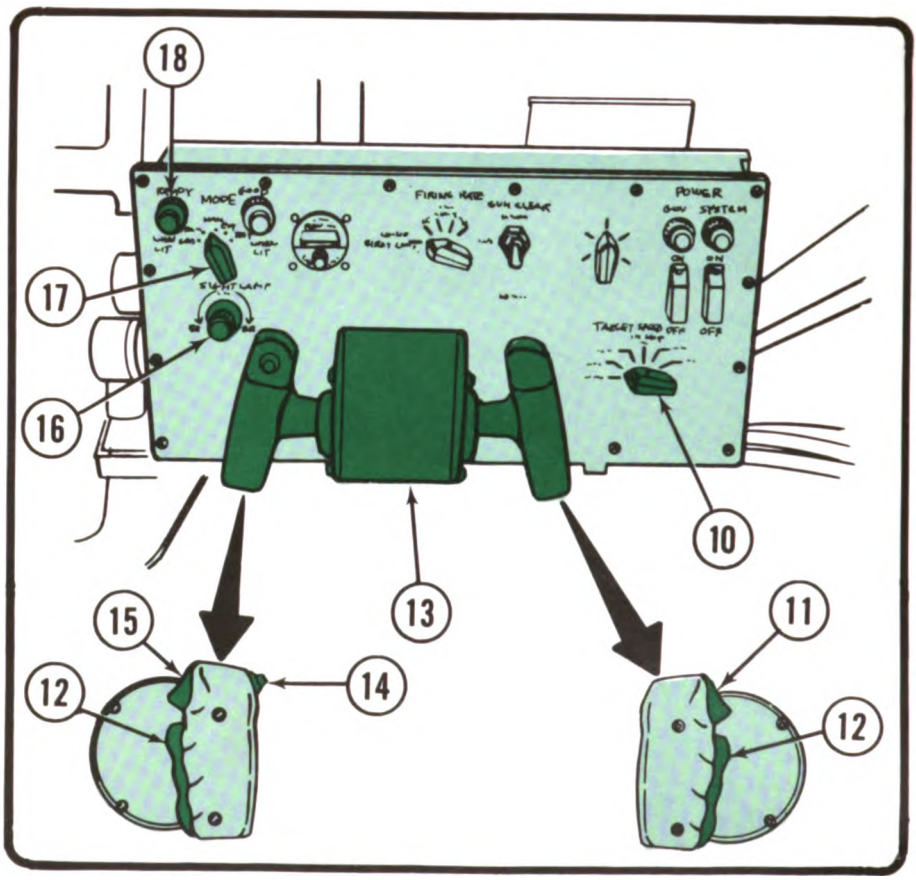
MOUNT – CONTINUED

CONTROL ASSEMBLY



10. TARGET SPEED knob—Set estimated speed in MAN mode.
11. Trigger switch (right handle)—fires cannon.
12. Action switch.
13. Elevation control—controls mount in azimuth and elevation.
14. Sight cage switch—cages sight.
15. Trigger switch (left handle)—dummy—no function.
16. SIGHT LAMP knob—controls sight reticle brightness.
17. MODE switch—
    GRD—lead computing feature of sight is not used.
    RADAR—target range and speed set automatically.
    MAN—target range and speed set by operator.
    EXT—range is set by external range control.
    TEST—used in prefire checks.
18. READY WHEN LIT indicator—lights when radar is ready (after 2 minute warmup).

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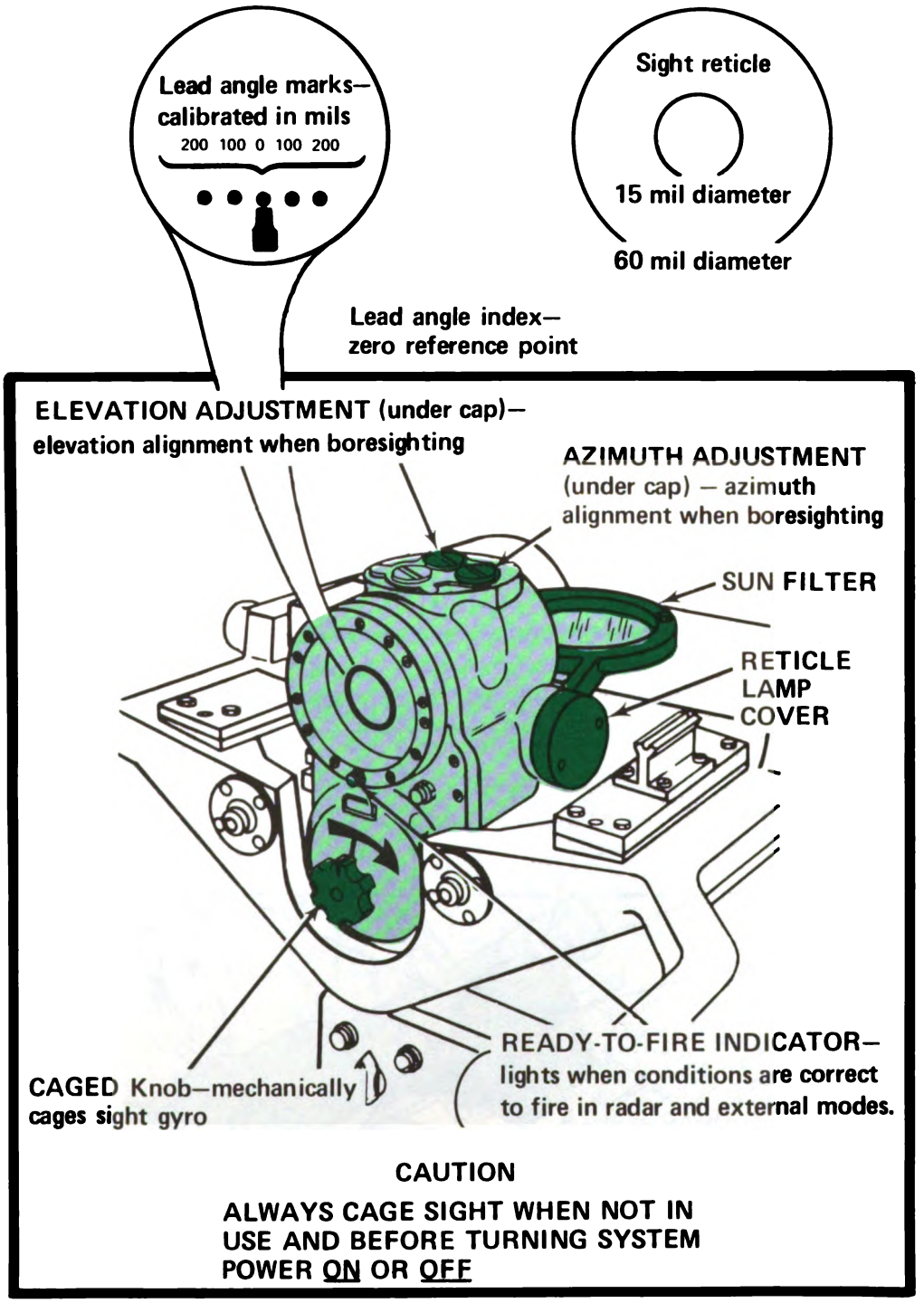
– CONTINUED

M61 SIGHT



CAUTION

ALWAYS CAGE SIGHT WHEN NOT IN USE AND BEFORE TURNING SYSTEM POWER ON OR OFF

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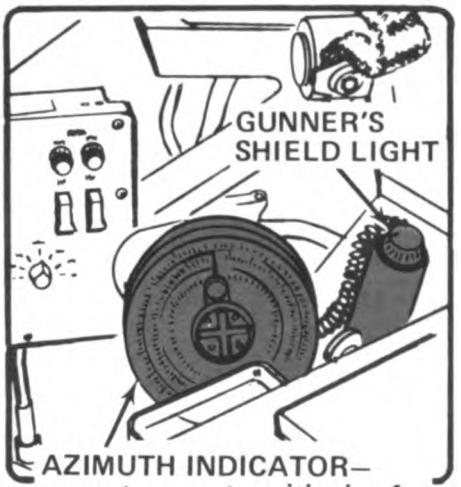
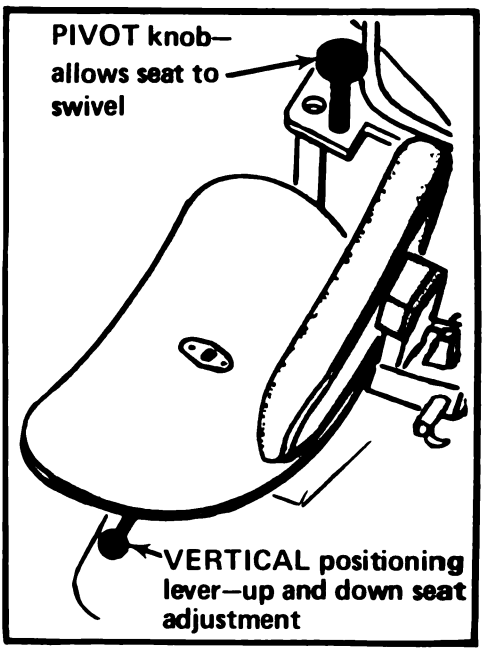
MOUNT – CONTINUED

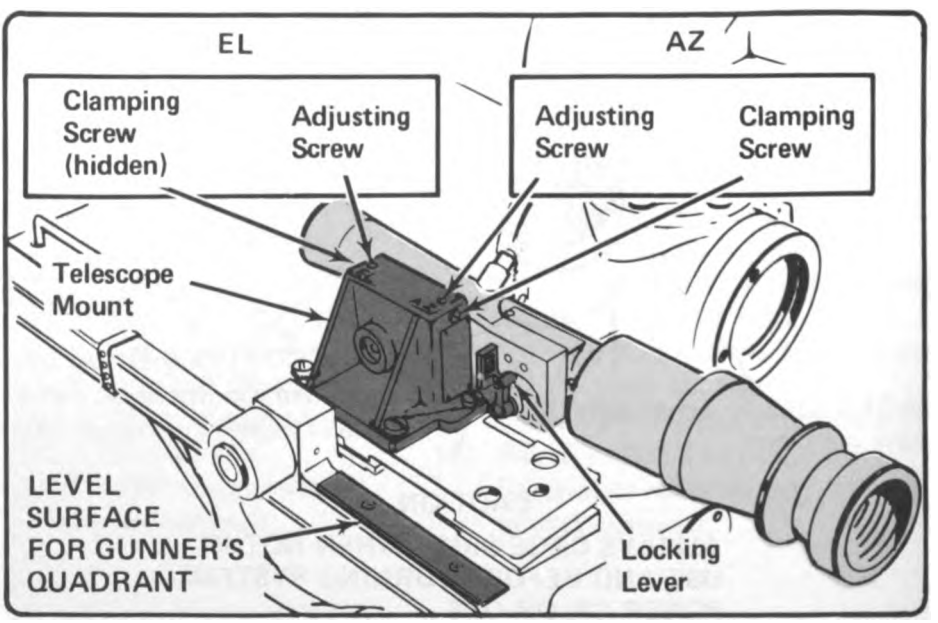
AZ INDICATOR



GUNNER'S SEAT



M134 TELESCOPE AND M164 MOUNT



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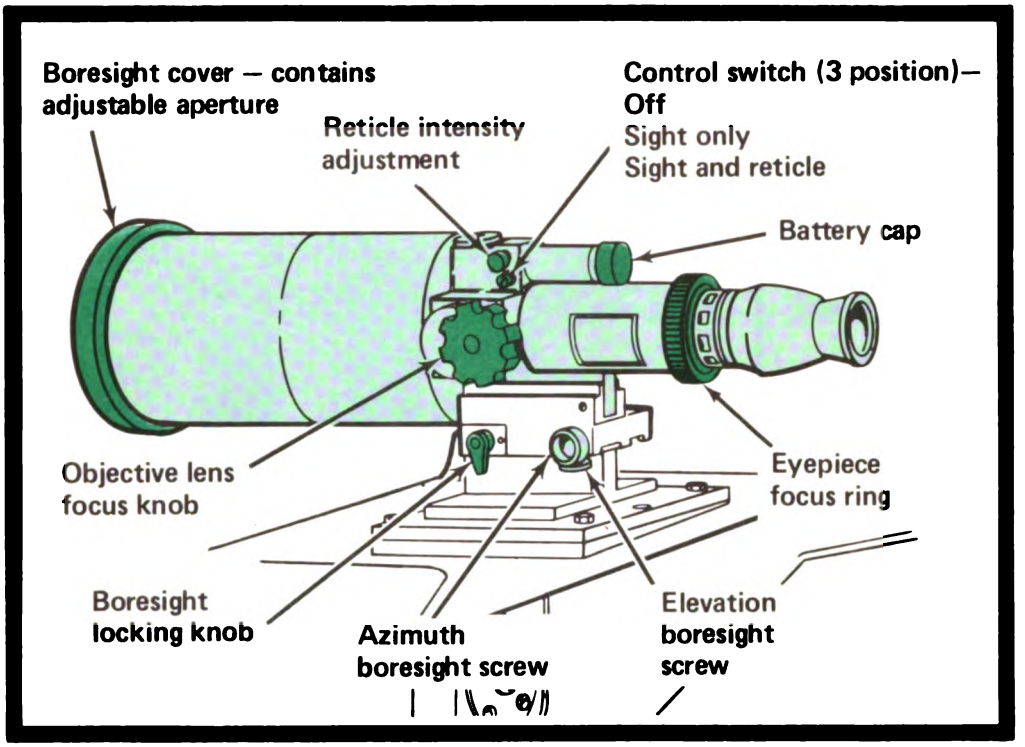
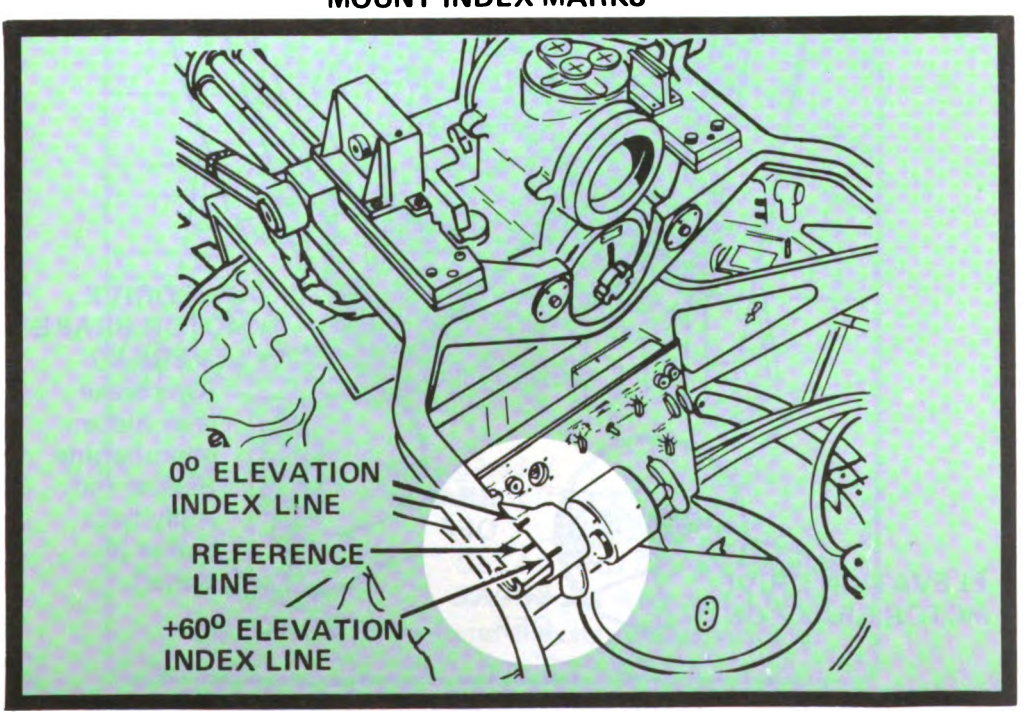
MOUNT – CONTINUED

AN/TVS–2B NIGHT VISION SIGHT



MOUNT INDEX MARKS



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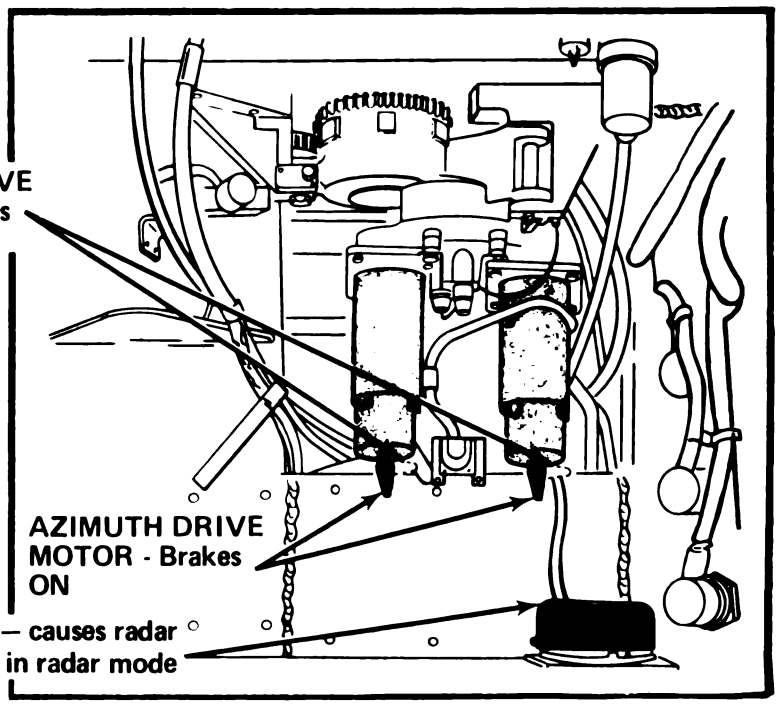
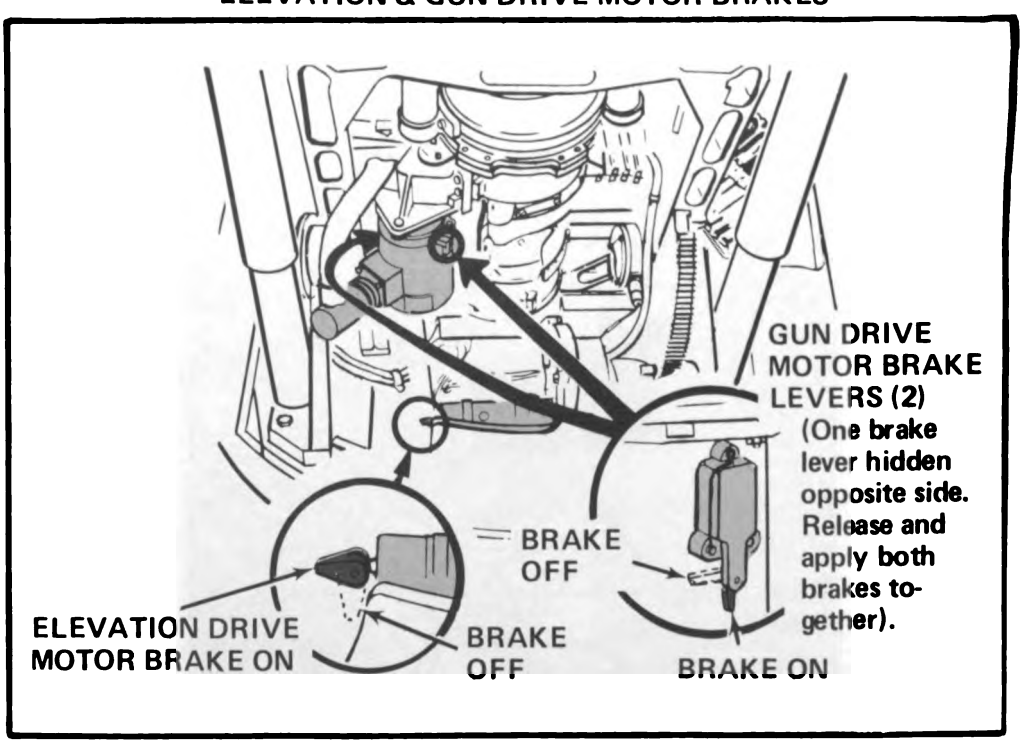
MOUNT – CONTINUED

FOOTSWITCH AND AZIMUTH DRIVE MOTOR BRAKES



ELEVATION & GUN DRIVE MOTOR BRAKES



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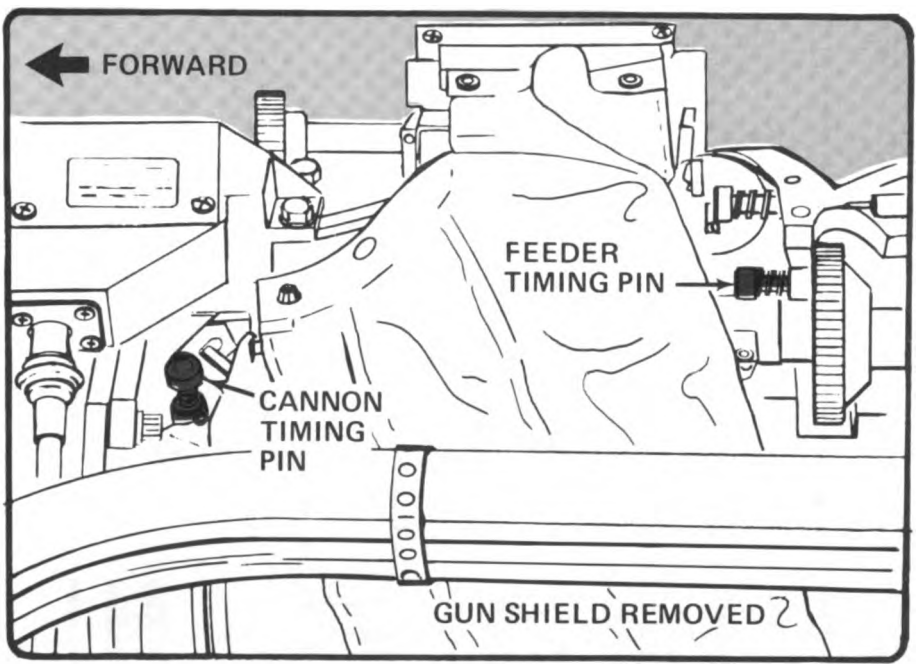
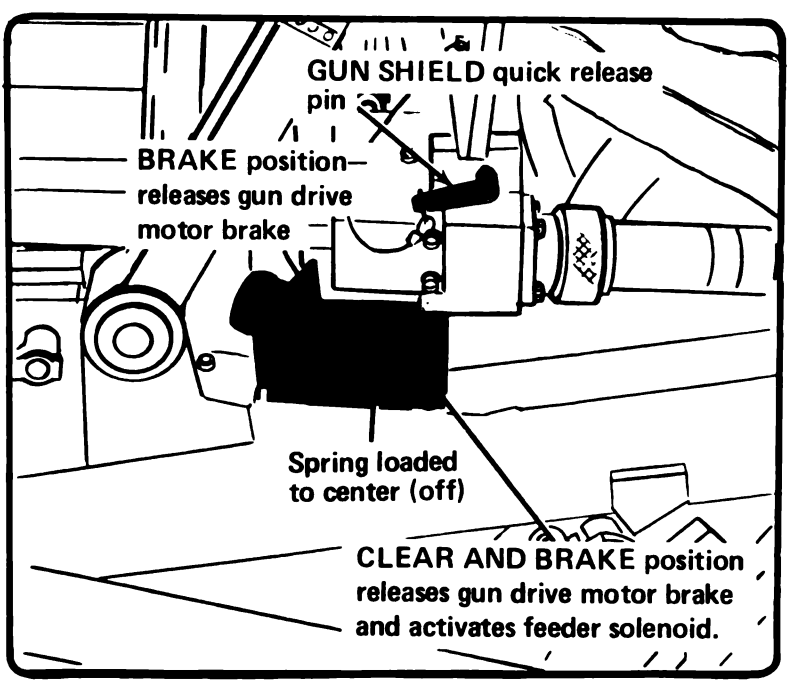
MOUNT – CONTINUED

CANNON AND FEEDER TIMING PINS



BRAKE-CLEAR AND BRAKE SWITCH



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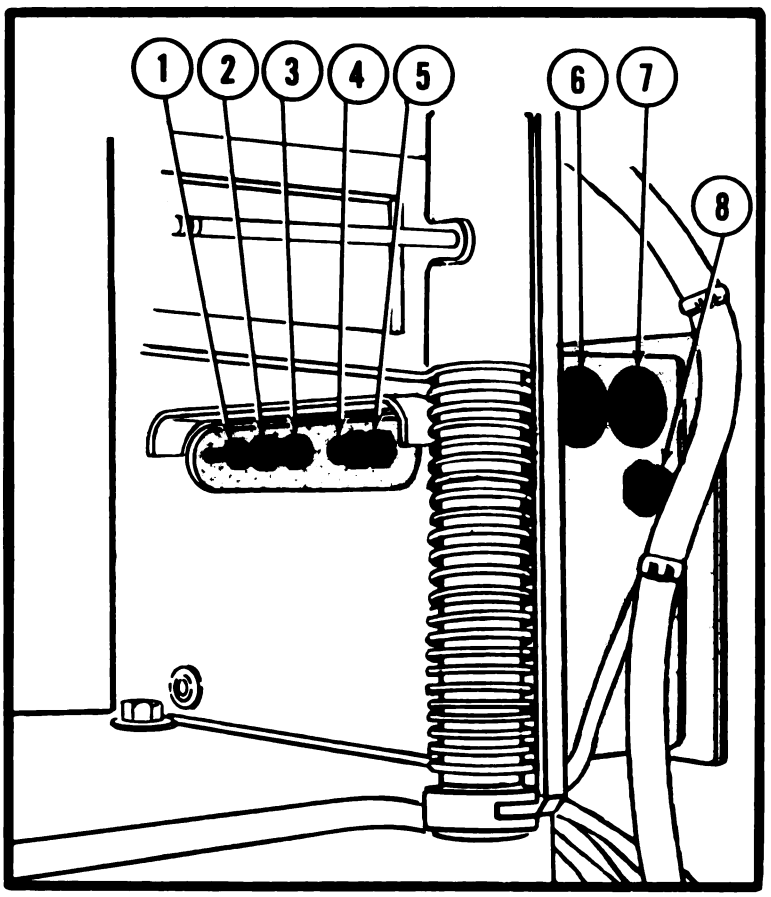
MOUNT – CONTINUED

DISTRIBUTION BOX



1. NORM–STATIC–TEST switch–
   NORM–System operates normally.
   STATIC–azimuth and elevation drive motors are powerless. Brakes on.
   TEST–Elevation servo and motor disabled. Azimuth servo and motor attempt to drive but brakes will not pick up electrically.
2. SIGHT GYRO PWR circuit breaker–protects sight gyro motor.
3. SCG PWR circuit breaker–protects sight current generator.
4. INVERTER PWR circuit breaker–protects inverter.
5. SYS PWR circuit breaker–protects weapon system.
6. VOLTS meter–shows voltage used to charge gun system batteries.
7. AMPS meter–shows current drawn from power source.
8. ELAPSED TIME meter–total time system power is applied (in tenths of hours).

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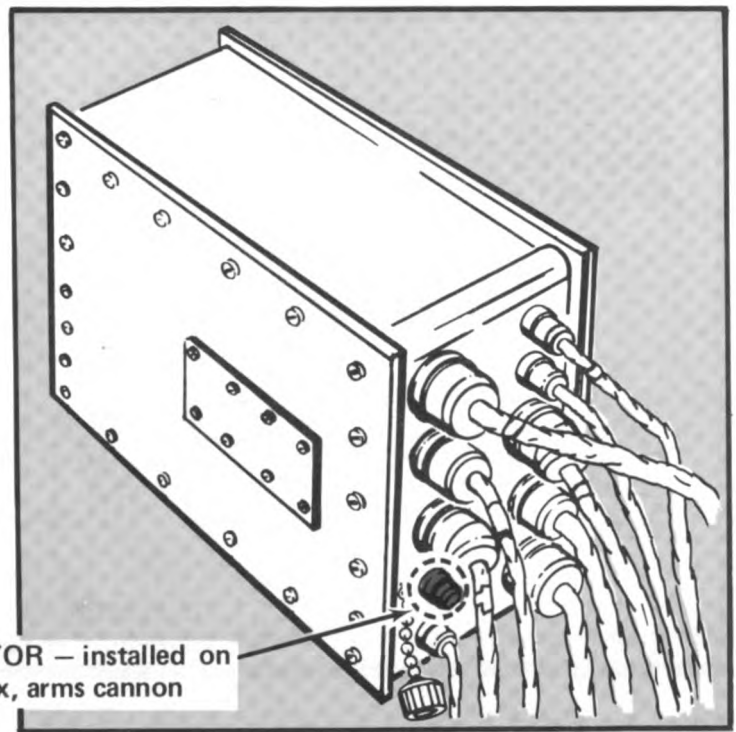
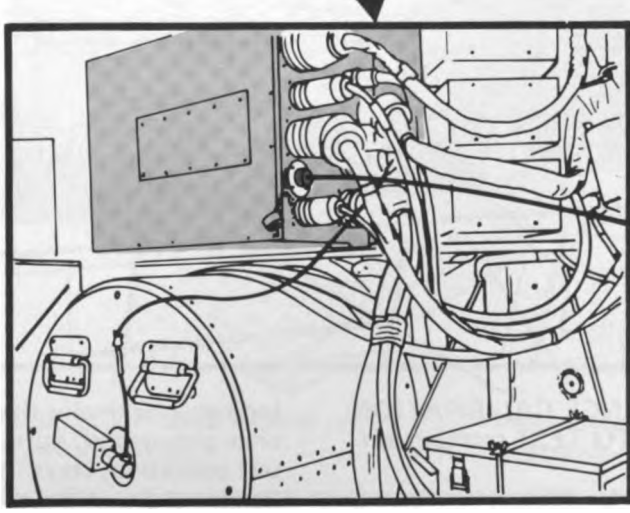
MOUNT – CONTINUED

DISTRIBUTION BOX – CONTINUED



ARMING CONNECTOR – installed on J6 of distribution box, arms cannon firing circuit.

ARM/SAFE SWITCH–installed on J6 of distribution box for training. Remotely arms cannon firing circuit.



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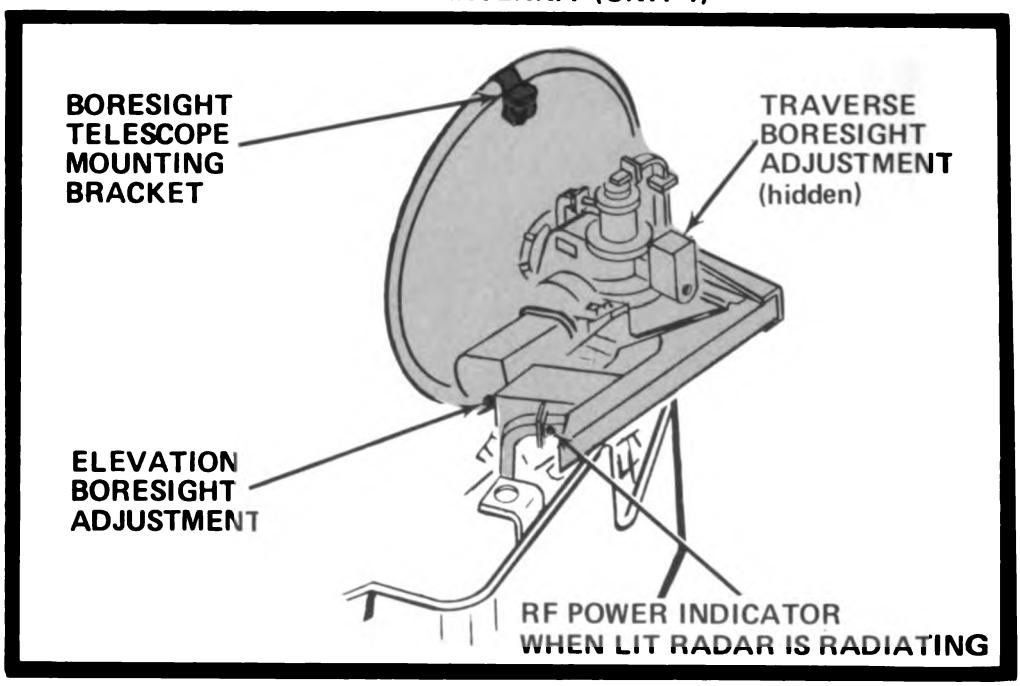
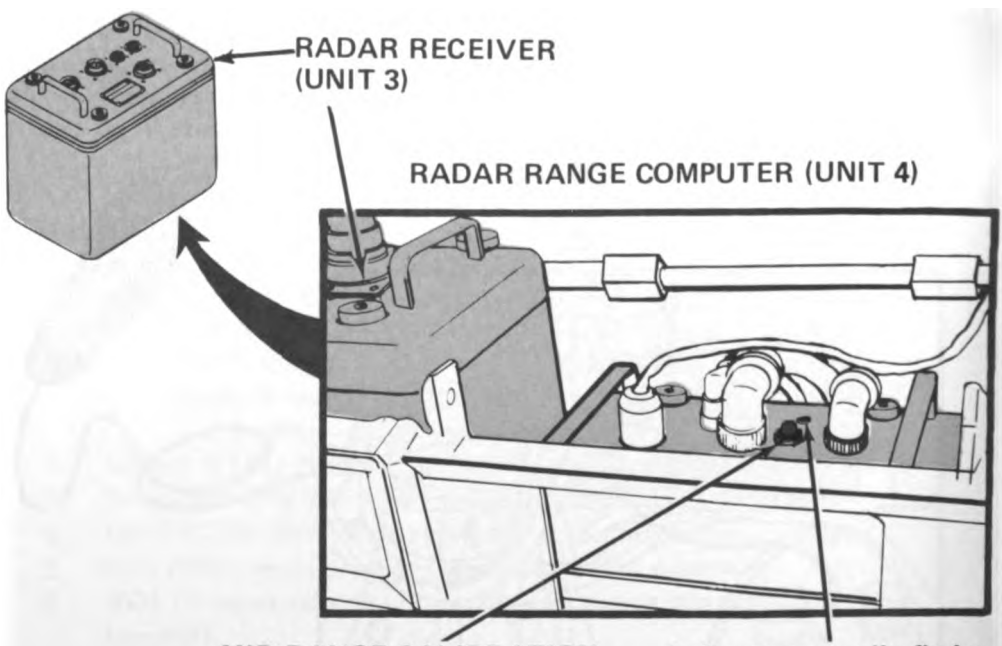
RADAR ANTENNA (UNIT 1)





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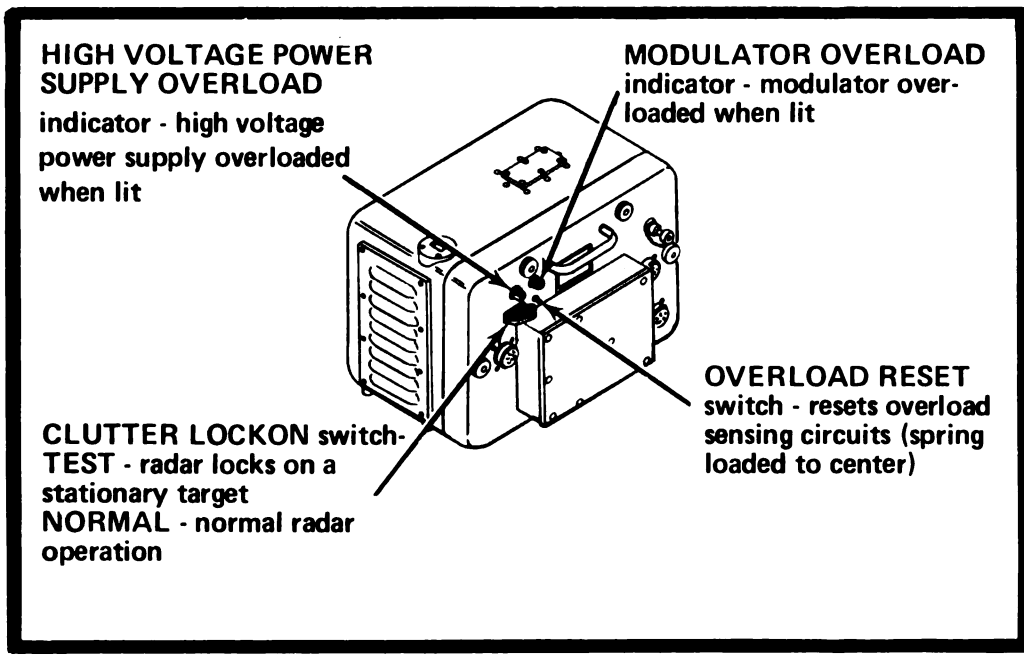
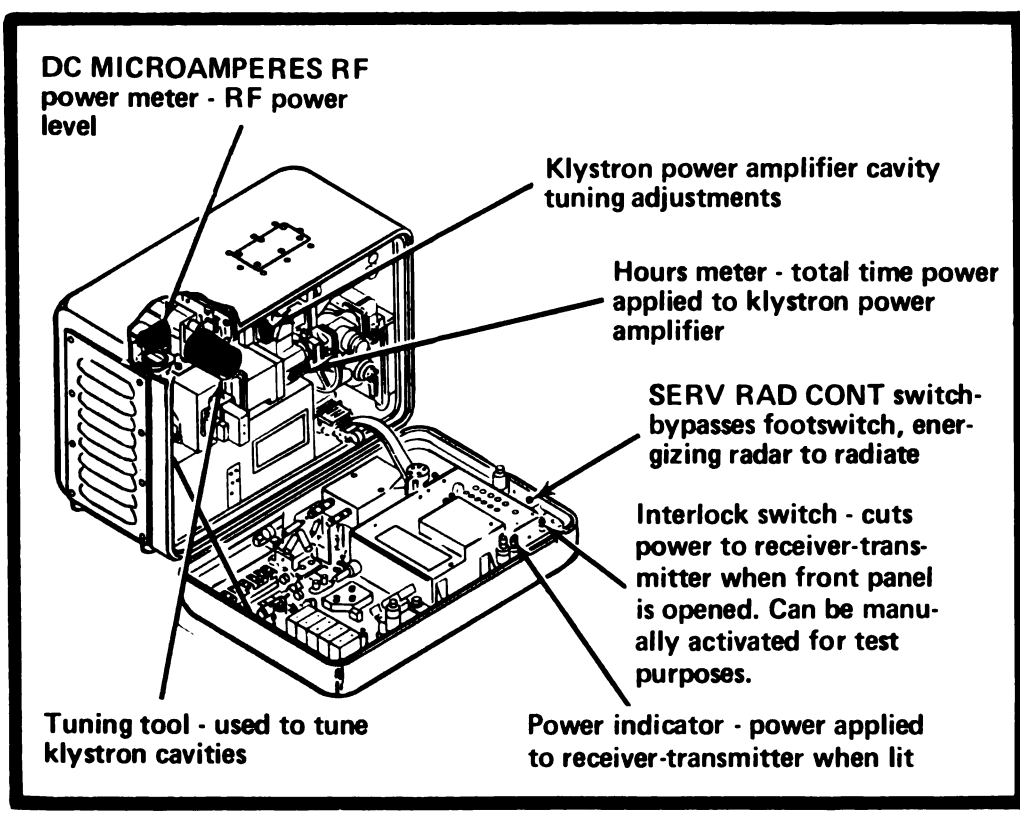
– CONTINUED

RADAR RECEIVER-TRANSMITTER (UNIT 2)





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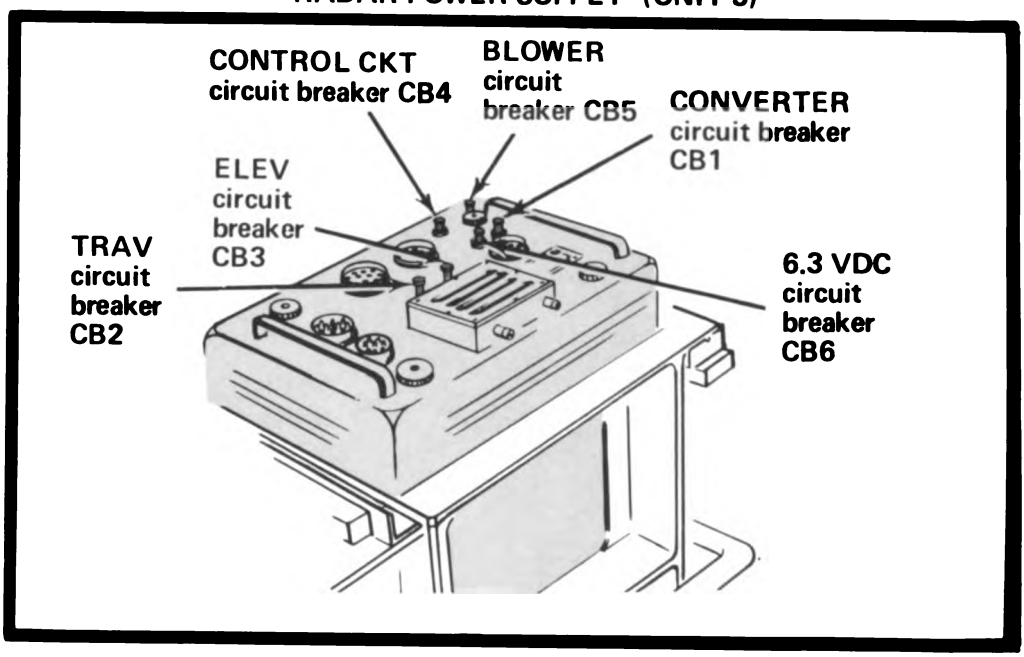
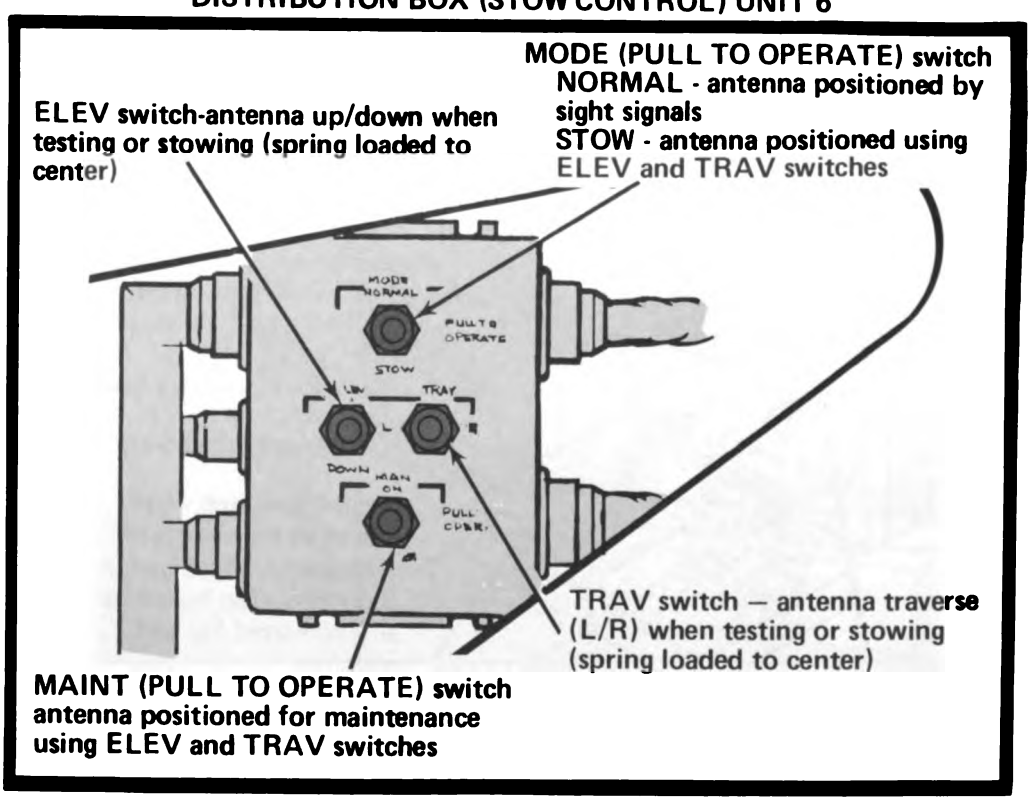
RADAR COMPONENTS – CONTINUED

RADAR POWER SUPPLY (UNIT 5)



DISTRIBUTION BOX (STOW CONTROL) UNIT 6



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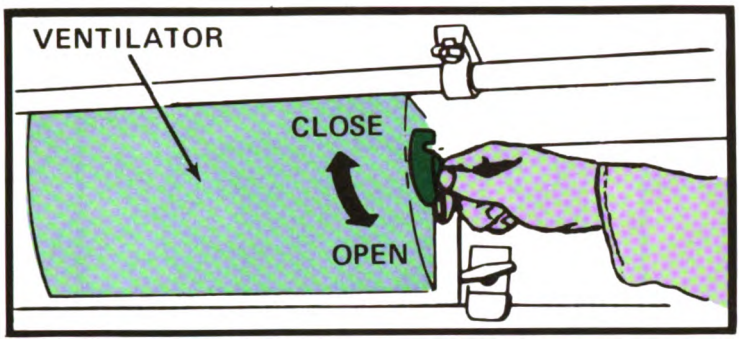
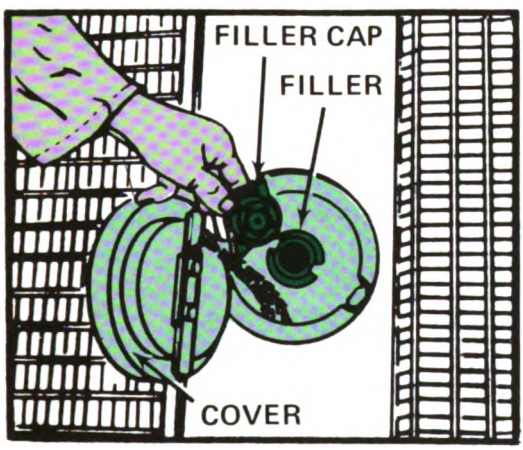
MISCELLANEOUS



CREW COMPARTMENT VENTILATOR HANDLE



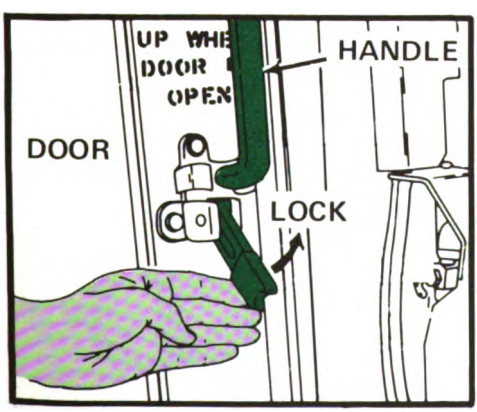
ENGINE COOLANT FILLER

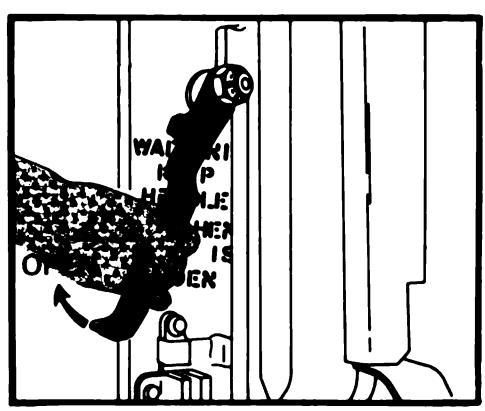
WARNING

If engine is hot, relieve pressure before removing coolant filler cap.

INTERIOR HANDLE— unlatches door and prevents ramp lowering with handle in fully open position

HANDLE RELEASE — locks door handle





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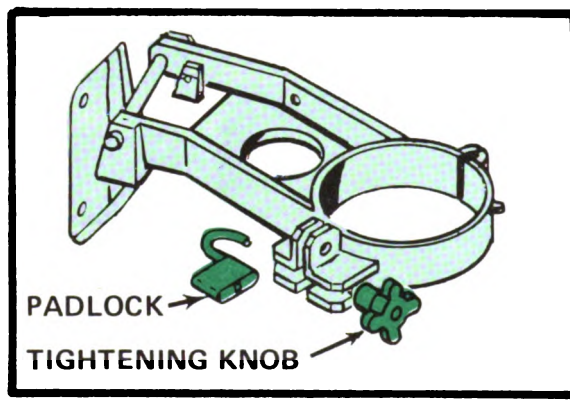
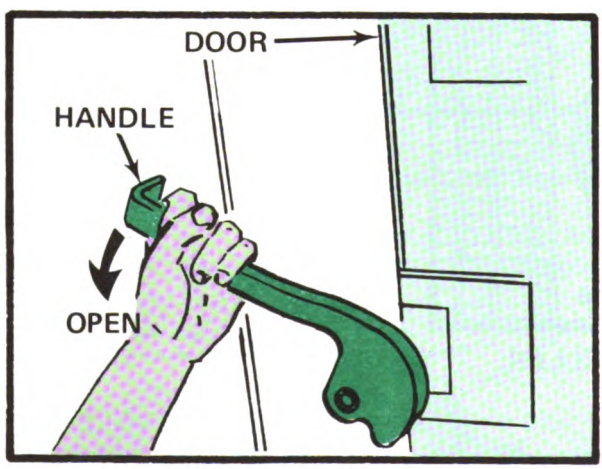
MISCELLANEOUS – CONTINUED

TRAVEL LOCK

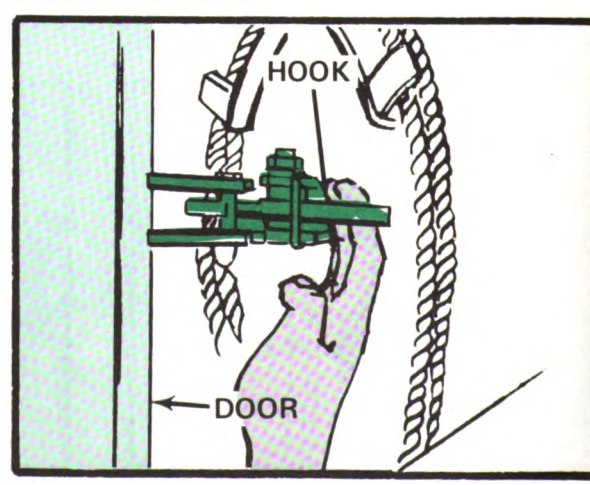


PERSONNEL DOOR CONTROLS



OUTSIDE DOOR LATCH

HOLD OPEN DOOR LATCH



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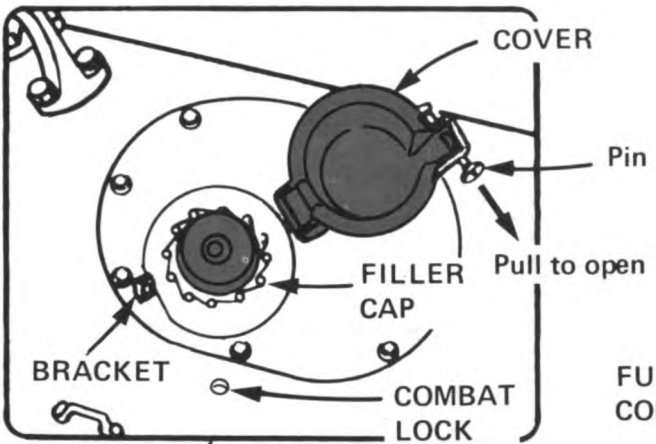
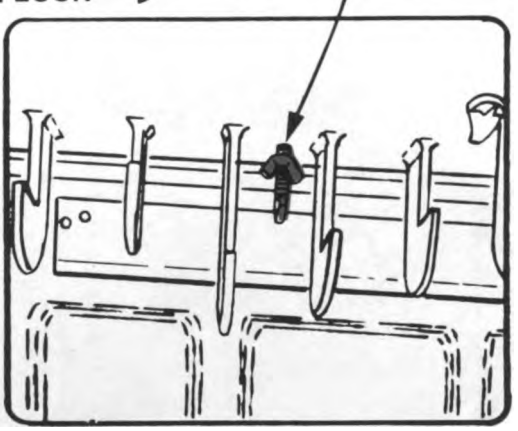
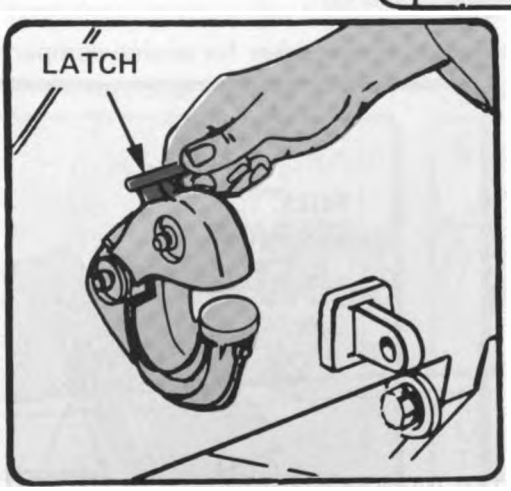
MISCELLANEOUS – CONTINUED

ENGINE FUEL FILLER







TOWING PINTLE

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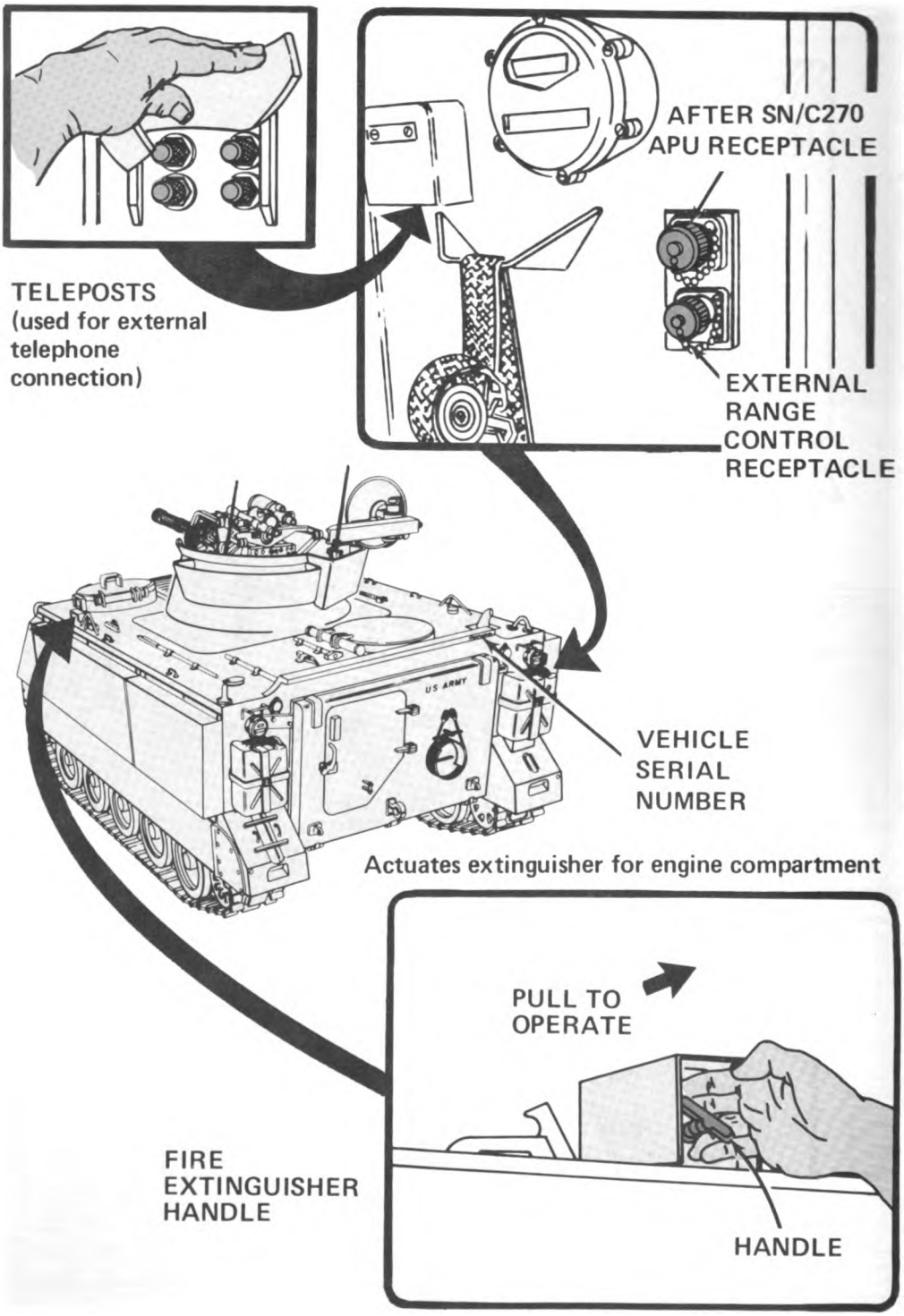
EXTERNAL CONTROLS



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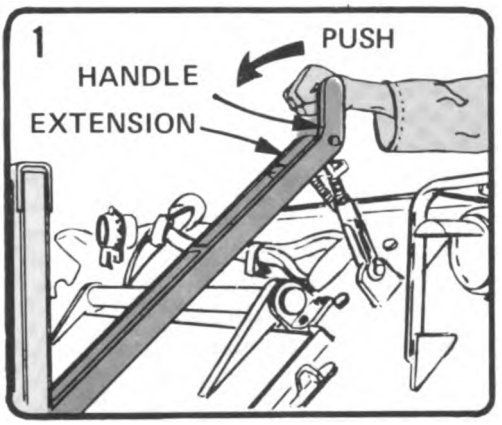
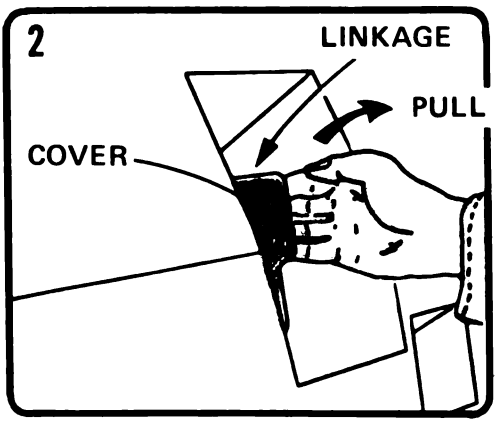
TRIM VANE, ENGINE ACCESS

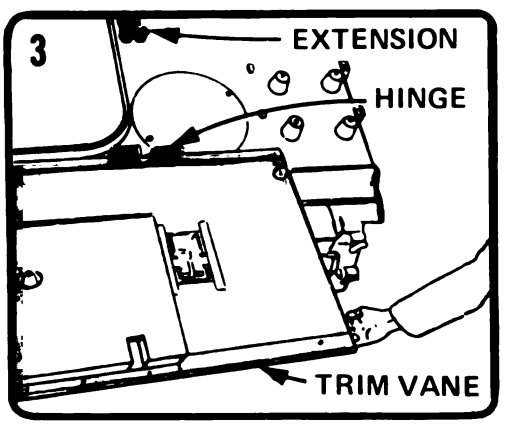
TRIM VANE HANDLE
– extends trim vane to stabilize chassis during water operations.



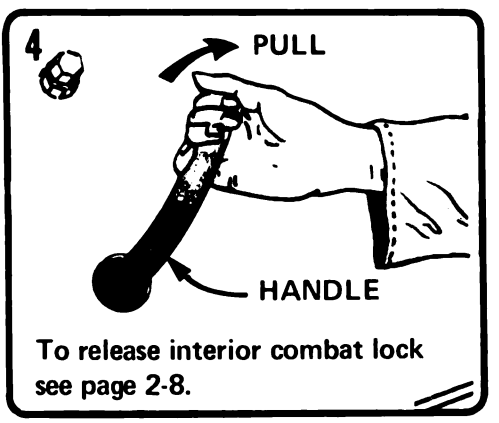
QUICK RELEASE – releases trim vane to expose engine access door.



TRIM VANE RELEASED

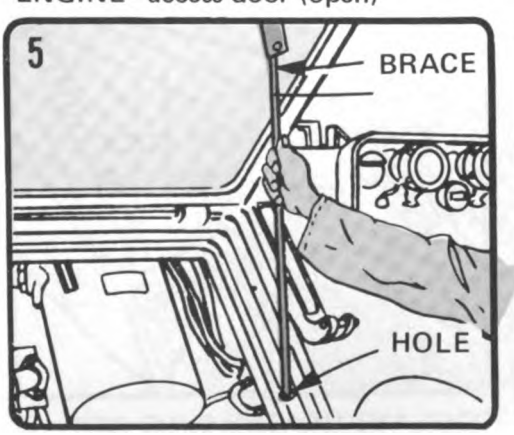


ENGINE–access door release handle

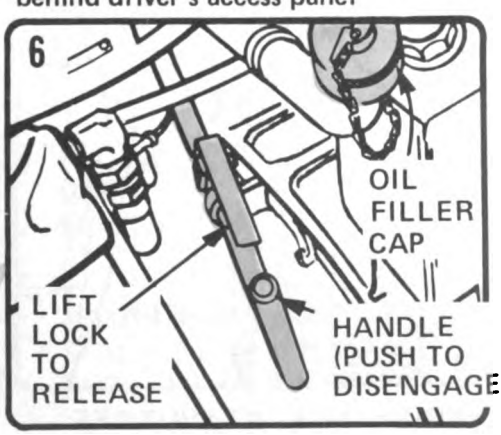


To release interior combat lock see page 2-8.

ENGINE–access door (open)



ENGINE–disconnect control handle
behind driver's access panel



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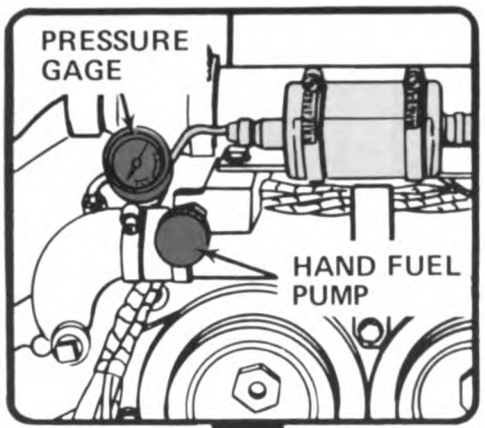
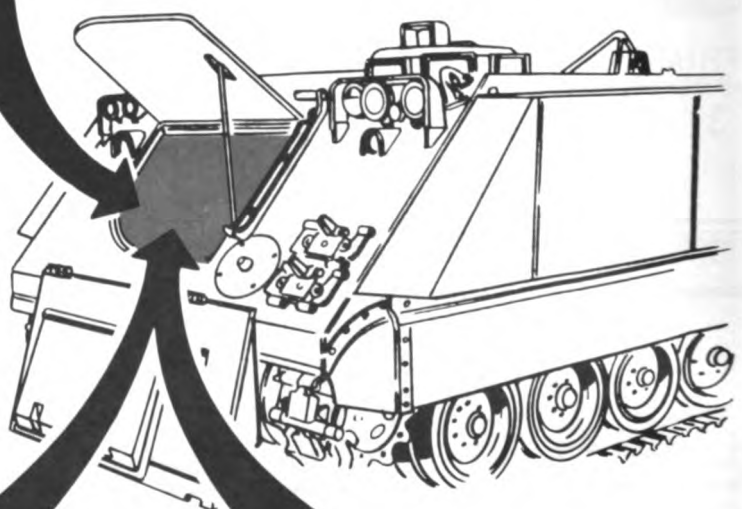
ENGINE COMPARTMENT

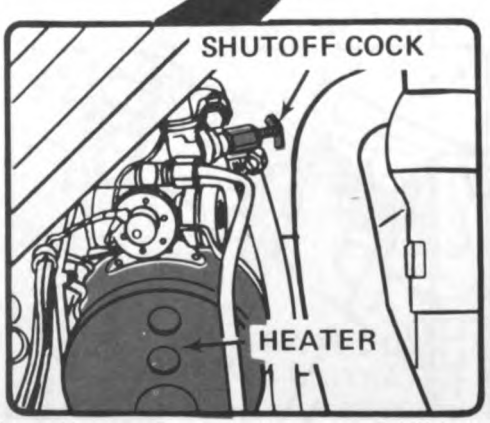


AIR BOX HEATER CONTROL

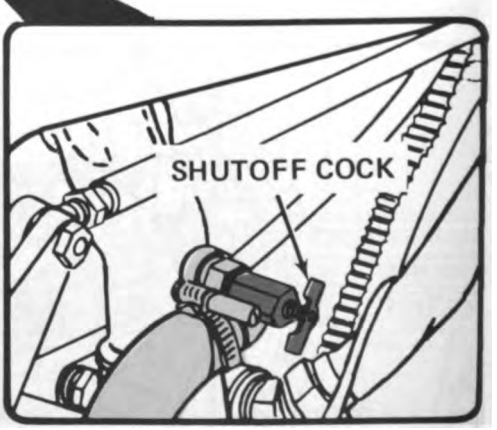
PRESSURE GAGE - air box heater accumulator pressure

HAND FUEL PUMP– builds up fuel pressure in accumulator for cold weather starting. Plunger releases with push and 90° counterclockwise turn.





ENGINE COOLANT SHUT OFF



COOLANT HEATER SHUT OFF

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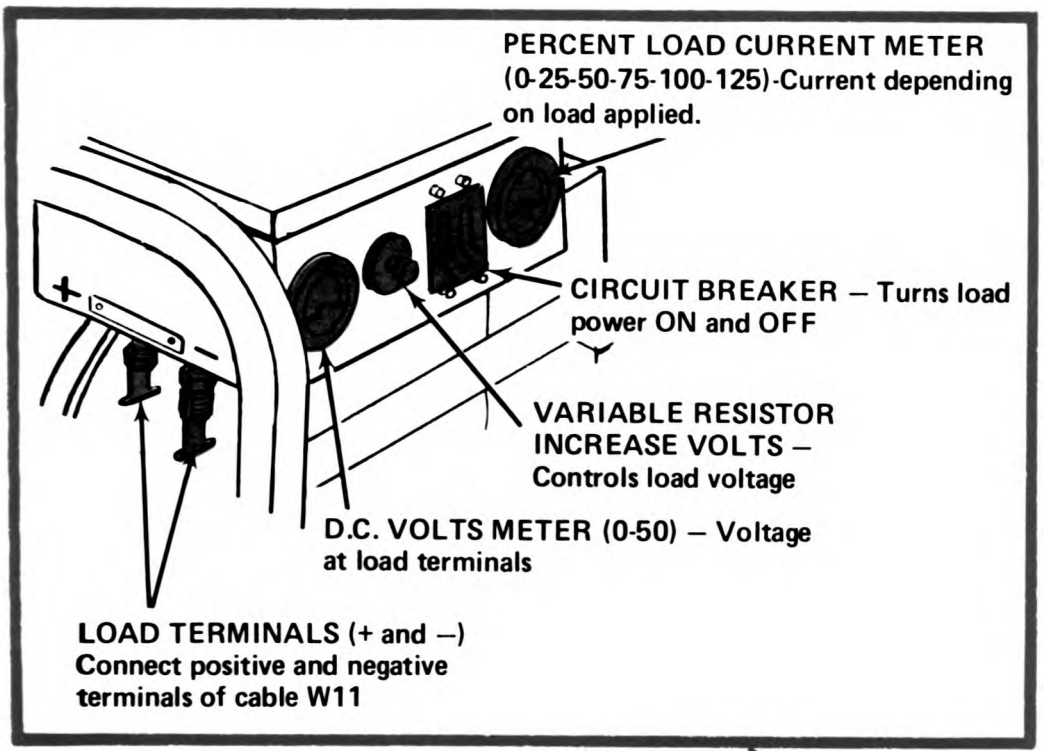
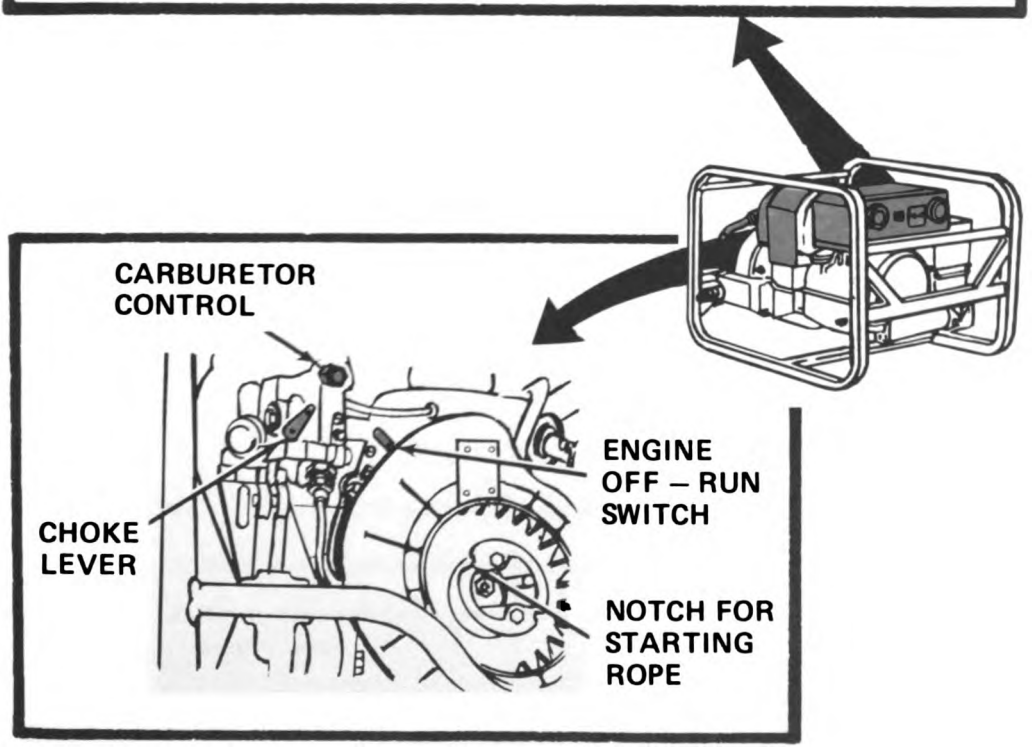
AUXILIARY POWER UNIT (APU)





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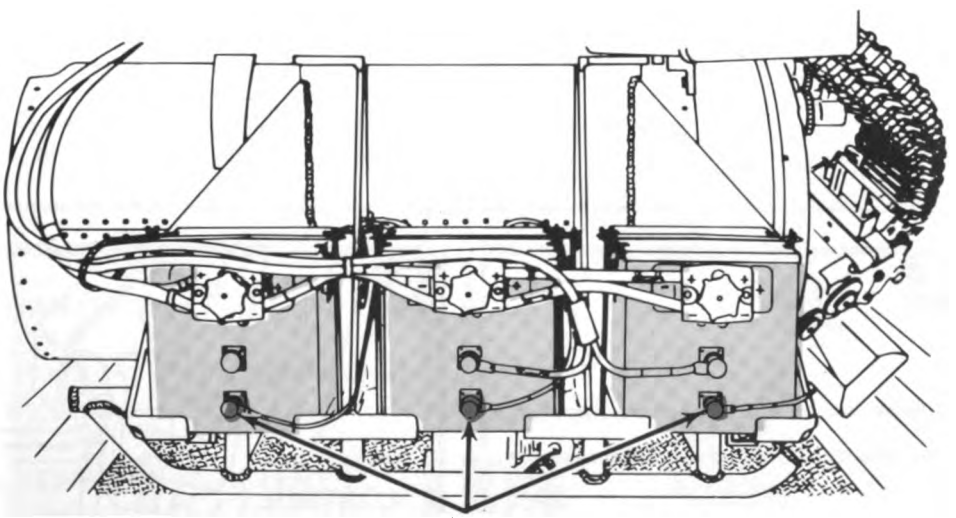
Section II.

OPERATION UNDER NORMAL CONDITIONS

2-2. This section covers operation of the system under normal conditions. Operation under unusual conditions is described in section IV of this chapter.

2-3. Refer to chapter 3, section VII for troubleshooting procedures that will help you isolate the cause of problems that may occur during operation. Section VII also contains recommended corrective actions.

2-4. Battery Taps. Make sure battery heater connections and taps are connected as shown:



BATTERY HEATER CONNECTORS (3)

IMPORTANT – When ambient temperature drops below 32°F . . . . . .

1. Make sure mount battery heaters are connected.
2. Notify organizational maintenance to check batteries for position of battery taps.

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1

DO your

Before Operation

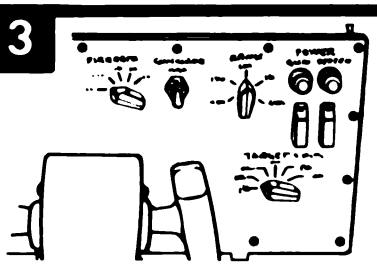
PMCS

2

IMPORTANT

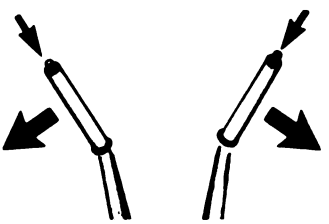
Turn off all electrical, communications, and radar equipment in driver's compartment, mount, and personnel compartment.

3



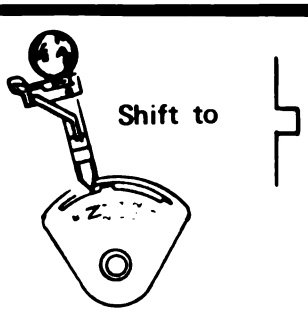
Flip SYSTEM POWER and GUN POWER switches to OFF.

4



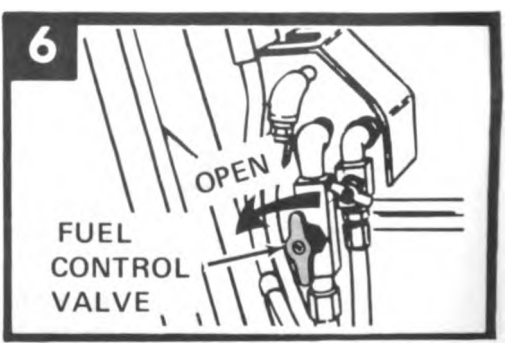
Pull back on steering levers and push buttons to lock brakes.

5

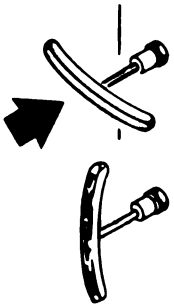


Shift to

6

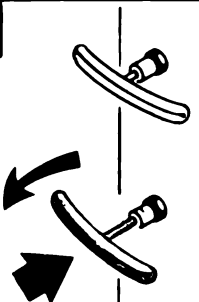


7



Push fuel cutoff control in.

8



Turn THROTTLE to unlock and push in.

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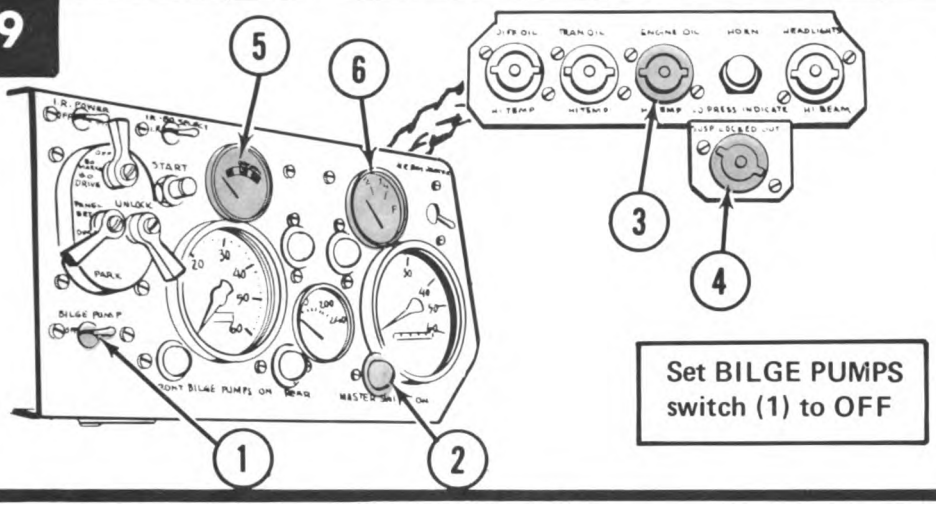
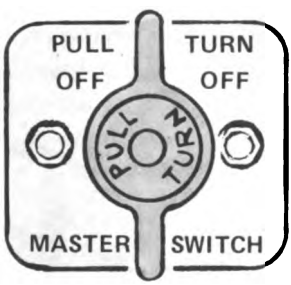
9



Set BILGE PUMPS switch (1) to OFF

10



TURN ON.

A. MASTER SWITCH ON light (2) is lit.

B. ENGINE OIL-HI TEMP-LO light (3) is lit.

C. SUSP LOCKED OUT light (4) is lit. (If susp is locked out).

D. BATTERY-GENERATOR (5) in yellow zone.

E. FUEL GAGE (6) indicates fuel level.

11

IMPORTANT – Do not crank engine for more than 15 seconds. Wait 30 seconds before pressing START switch again.

12

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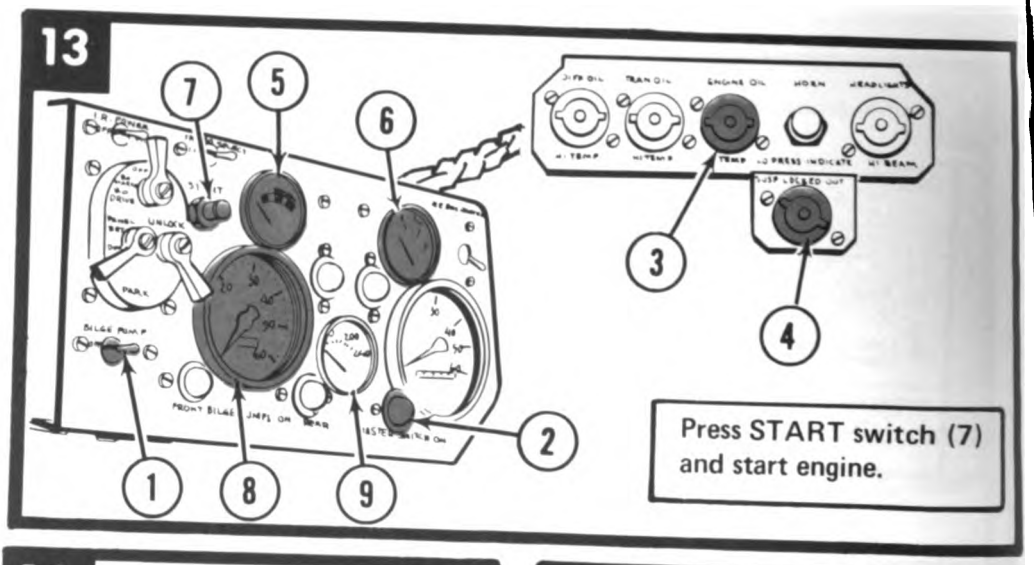
STARTING INSTRUCTIONS ABOVE 40°F – CONTINUED

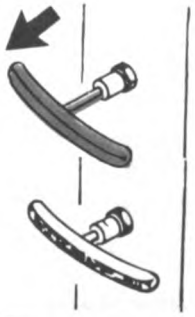
13



Press START switch (7) and start engine.

14

IMPORTANT – All indicator lights should go out within 10 seconds after engine starts. If any lights stay lit (except SUSP LOCKED OUT light when susp is locked out), pull out fuel cutoff control to stop engine and notify organizational maintenance.



15

CAUTION – Do not let tachometer (8) reading go over 2975 rpm under any circumstances.

16

Pull out hand THROTTLE until engine runs at 800 to 1000 rpm. Lock hand THROTTLE and let engine warm up 3 to 5 minutes.

17

After warmup, unlock hand THROTTLE and push in.

A. Tachometer (8) reads 550 to 600 rpm idle speed.

B. BATTERY-GENERATOR (5) in green zone.

C. TEMP F (9) not over 200°F.

18

IMPORTANT – If you idle engine for over an hour, set hand THROTTLE for 800 to 1000 rpm.

END

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STARTING INSTRUCTIONS 40°F TO -25°F

1

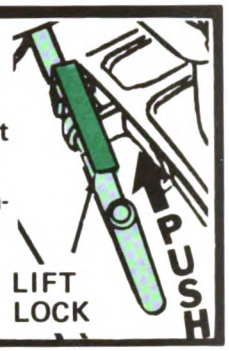
DO your

Before Operation

PMCS

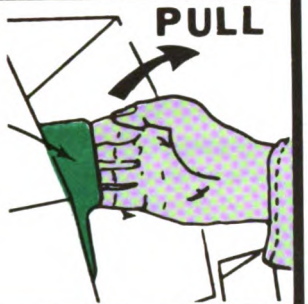
2

Remove interior engine compartment panels and disengage engine by pushing disconnect handle in.



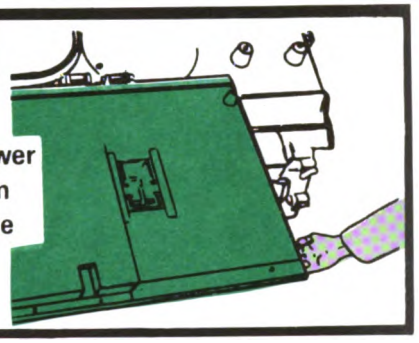
3

Release trim vane from extension linkage.



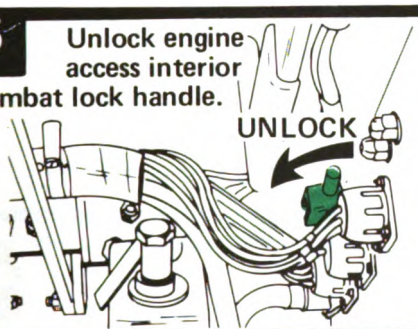
4

Lower trim vane



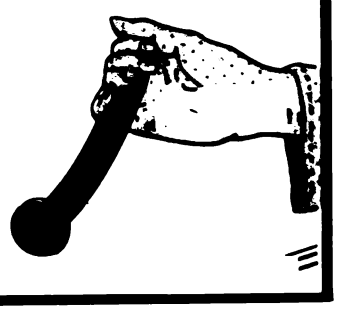
5

Unlock engine access interior combat lock handle.



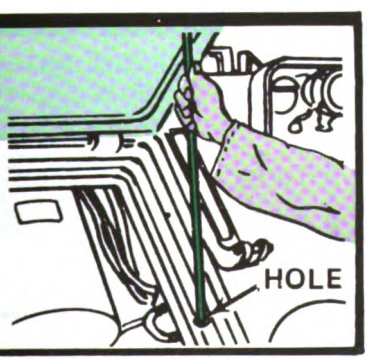
6

Unlock engine access door.



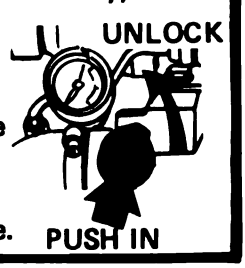
7

Open engine access door



8

Check accumulator pressure indicator. If necessary, recharge to yellow zone with hand pump. If you can't get the right indication, notify organizational maintenance.



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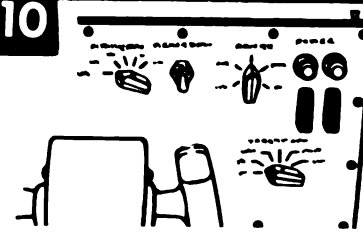
STARTING INSTRUCTIONS 40°F TO 25°F – CONTINUED

9

IMPORTANT

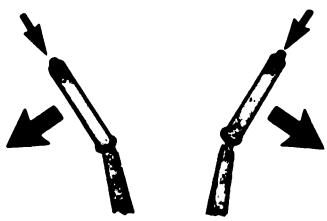
Turn off all electrical, communications, and radar equipment in driver's compartment, mount, and personnel compartment.

10



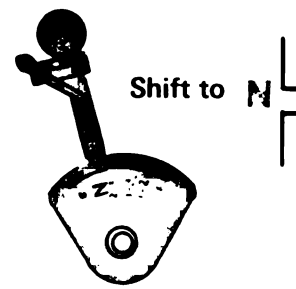
Flip SYSTEM POWER and GUN POWER switches to OFF.

11

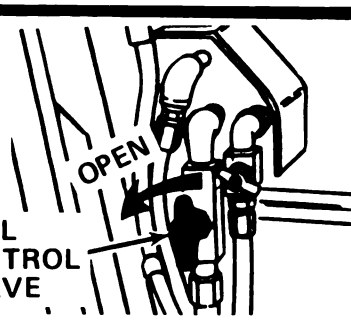


Pull back on steering levers and push buttons to lock brakes.

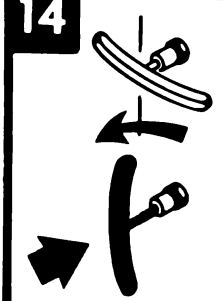
12



13



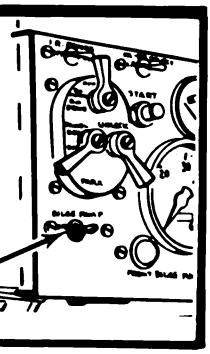
14



Turn THROTTLE to unlock and push in.

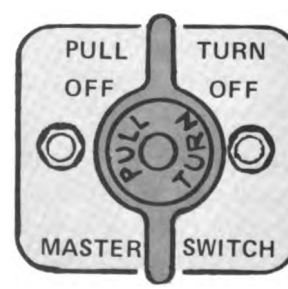
15

Set BILGE PUMPS switch to OFF.



16

Turn ON



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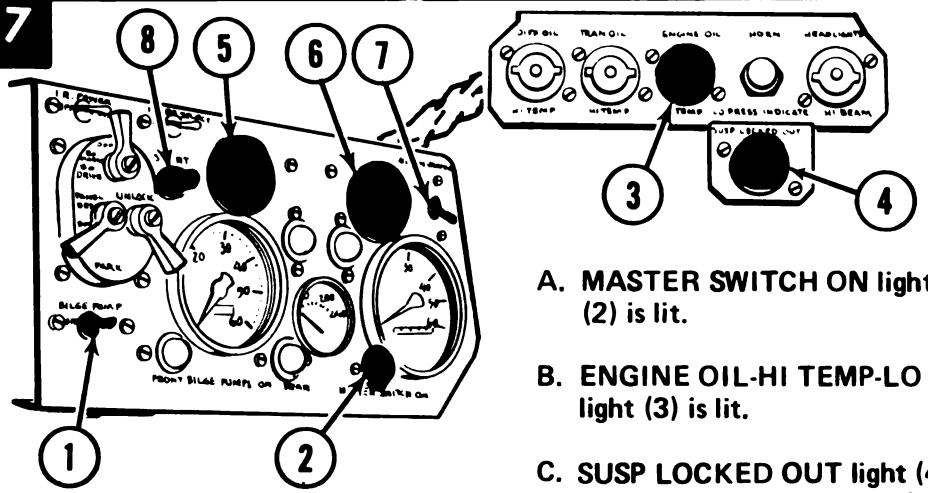
STARTING INSTRUCTIONS 40°F TO 25°F – CONTINUED

17



A. MASTER SWITCH ON light (2) is lit.

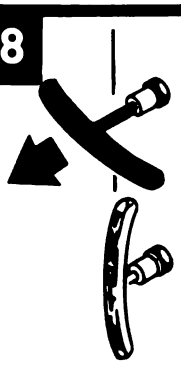
B. ENGINE OIL-HI TEMP-LO light (3) is lit.

C. SUSP LOCKED OUT light (4) is lit. (If susp is locked out).

D. BATTERY-GENERATOR (5) in yellow zone.

E. FUEL GAGE (6) indicates fuel level.

18



Pull fuel cutoff control out.

19

IMPORTANT – Do not crank engine for more than 15 seconds. Wait 30 seconds before pressing START switch again.

20

WARNING – Monoxide gas may be present in vehicle if interior engine compartment panels are not in place. Before starting, assure that panels are properly installed.

21

Press up on AIR BOX HEATER switch (7) for 1 to 2 seconds. Press START switch (8) for 4 to 6 seconds.

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STARTING INSTRUCTIONS 40°F TO -25°F – CONTINUED

22

A. Push fuel cutoff control in.

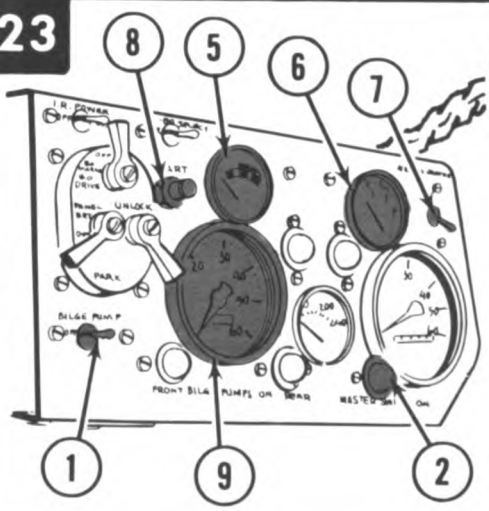
CAUTION

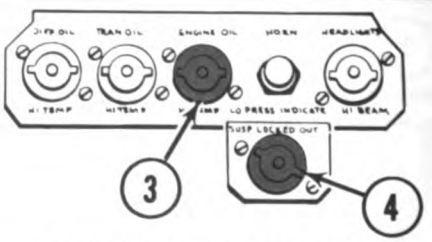
Go easy on accelerator or engine will over-rev after starting.

B. Continue cranking engine while pressing AIR BOX HEATER switch (7) up (one second) and down (two seconds) until engine starts.

C. Release START switch (8) but continue to cycle AIR BOX HEATER switch until engine is running.

23





IMPORTANT—All indicator lights should go out within 10 seconds after engine starts. If any lights stay lit (except SUSP LOCKED OUT light when SUSP is locked out), pull out fuel cutoff control to stop engine and notify organizational maintenance.

24 CAUTION—Do not let tachometer (9) reading go over 2975 rpm under any circumstances.

25 Pull out hand THROTTLE until engine runs at 550 to 1000 rpm. Lock hand THROTTLE and let engine warm up 3 to 5 minutes.

26 Turn off engine coolant heater, if installed (Page 2-134).

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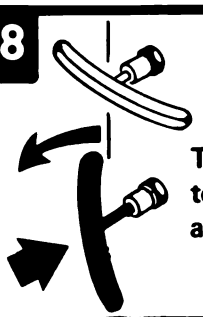
STARTING INSTRUCTIONS 40°F TO -25°F – CONTINUED

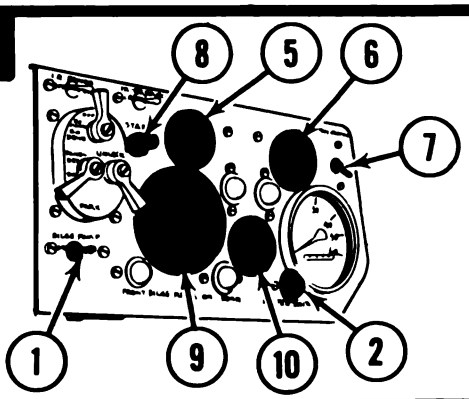
27 Pull out hand THROTTLE until engine runs at 1200 to 1500 rpm. Lock hand THROTTLE and let engine warm up 5 minutes.

28



Turn THROTTLE to unlock and push in.

29



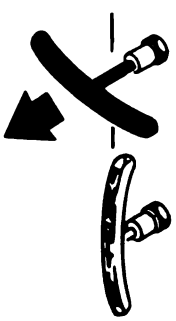
A. Tachometer (9) reads 550 to 600 rpm idle speed.

B. BATTERY-GENERATOR (5) in green zone.

C. TEMP F (10) not over 200°F.

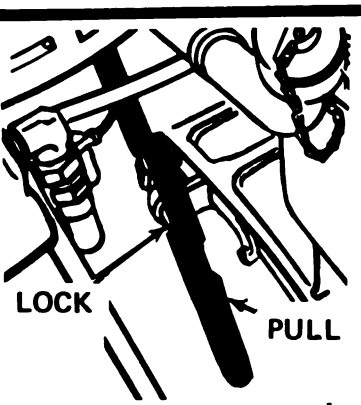
30 CAUTION—Do not operate engine disconnect handle with engine running.

31



Pull fuel cutoff control out to stop engine.

32



Open engine access panel.

Pull disconnect handle to engage engine and drive train. If handle will not lock, maintain pressure on handle and momentarily hit START switch (8).

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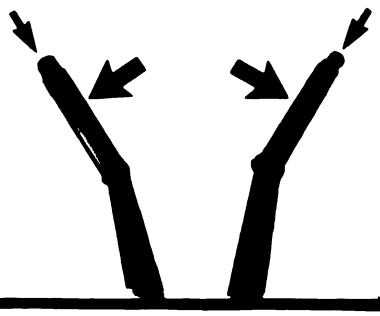
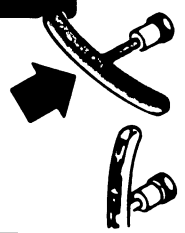
– CONTINUED

33



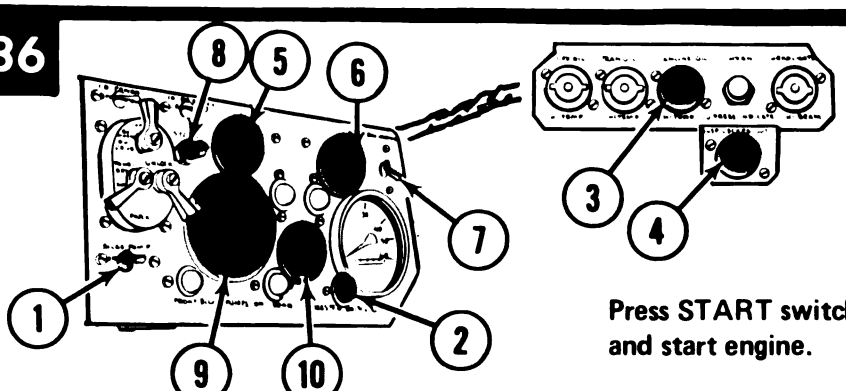
34



Push fuel cutoff control in.

35

36



Press START switch (8) and start engine.

37

Shift to 2-3

38 Pull out hand THROTTLE until engine runs at 800 to 1000 rpm. Lock hand THROTTLE and let transmission warm up 3 to 10 minutes.

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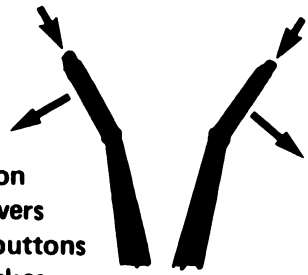
STOPPING THE ENGINE

1

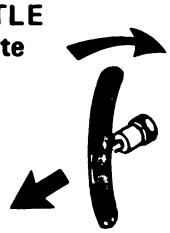


Pull back on steering levers and push buttons to lock brakes

2

Shift to **N**

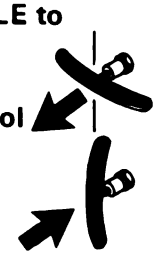
3 Pull out hand THROTTLE until engine runs at 1000 rpm. Lock hand THROTTLE and let engine operate for 2 minutes.



4

Turn hand THROTTLE to unlock and push in.

Pull fuel cutoff control out.



5

IMPORTANT

Turn off all electrical, communications, and radar equipment in driver's compartment, mount, and personnel compartment.

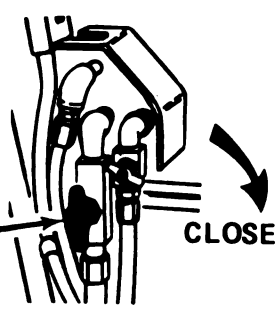
6

CAUTION

Do not turn off MASTER SWITCH until engine has stopped running.

Turn **OFF**

7



FUEL CONTROL VALVE

CLOSE

8

If air temperature is below or expected to drop below -25°F, start engine coolant heater (page 2-134).

END

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DRIVING VEHICLE

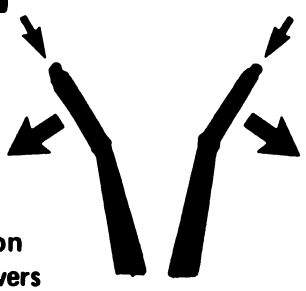
2-5. Your vehicle has two independent steering and braking systems. Knowing how and when to use them will both increase vehicle maneuverability and prevent you from losing control of the vehicle. IMPORTANT – Never use both systems at the same time.

DIFFERENTIAL STEERING AND BRAKING SYSTEM

DRIVING CAUTIONS

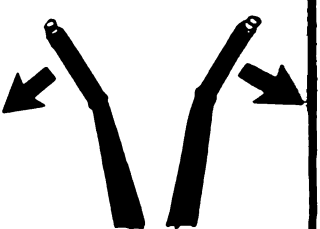
DON'T touch lock buttons on top of hand grips when steering vehicle.
DON'T oversteer on hard surfaces at speeds that may cause vehicle to go out of control.
DON'T brake if track is thrown; coast to a stop.
DO steer in a series of short turns when operating in loose sand, dirt, or rock.

PARK



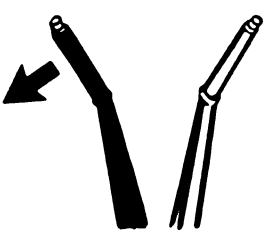
Pull back on steering levers and push buttons to lock brakes.

STOP



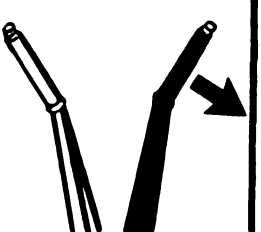
Pull back on both levers equally to slow or stop vehicle.

LEFT



Pull back on left steering lever to make a left turn.

RIGHT



Pull back on right steering lever to make a right turn.

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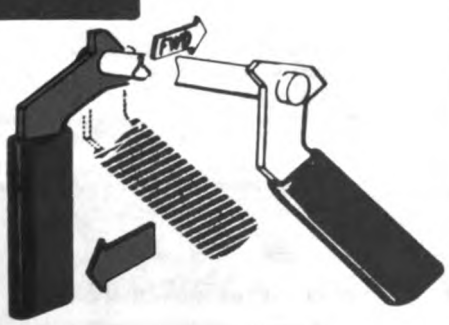
PIVOT STEERING AND BRAKING SYSTEM

DRIVING CAUTIONS

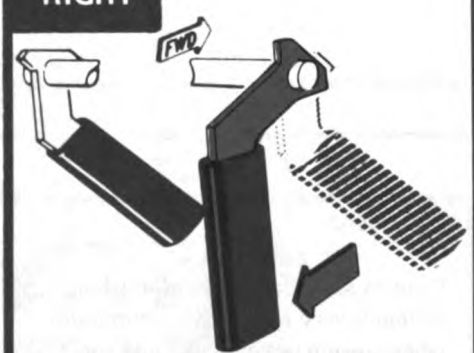
DON'T use pivot steer levers and differential steer levers at the same time.
DON'T use pivot steer at speeds above 15 MPH.
DON'T brake if track is thrown; coast to a stop.
DON'T oversteer on hard surfaces at speeds that may cause vehicle to go out of control.
DO steer in a series of short turns when operating in loose sand, dirt, or rocks.
DO shift transmission to 1-2 range when using pivot steer.

LEFT



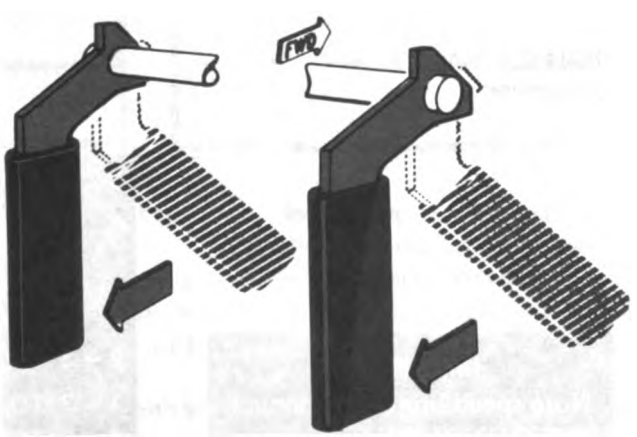
Pull back on left pivot lever to make a left turn.

RIGHT



Pull back on right pivot lever to make a right turn.

EMERGENCY STOP



Pull back on both pivot steer levers at the same time to stop vehicle in an emergency.

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TRANSMISSION

- Your vehicle is equipped with an automatic transmission. It does not have to be shifted manually, except in certain situations.
- Select proper gear range depending on terrain to be traveled.
- Upshifts or downshifts are automatic through gears of selected range.
- IMPORTANT – Know and select correct gear range for terrain before driving.

DRIVING CAUTIONS

DON'T shift to R (reverse) when vehicle is moving forward.
DON'T shift to N (neutral) and coast when going downhill.
DON'T hold vehicle on hills by using accelerator.
DO downshift before starting downhill.

Suggested use of gears

1st gear

Used to set vehicle in motion when terrain is very rough, soft, or muddy—when towing heavy loads—and for going up or down very steep grades. Max. speed 10 MPH.

2nd gear

Used to set vehicle in motion on hard surface—towing heavy loads—and for going up and down long steep grades. Max speed 21 MPH.

3rd gear

Used for maximum speed on hard level ground. Max speed 40 MPH.

Reverse gear

Used to back up vehicle. Max speed 9 MPH.

Manual shifting is required only to avoid excessive automatic shifting or overloading the engine.

IMPORTANT
Note speed limits for manual shifting.

SPEED LIMITS FOR MANUAL DOWN SHIFT WITH SHIFT LEVER

SHIFT RANGE	
2 – 3 TO 1 – 2 – 3 RANGE	40 MPH
1 – 3 TO 1 – 2 RANGE	21 MPH
1 – 2 TO 1 RANGE	10 MPH

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TRANSMISSION – CONTINUED

Select a gear range in which vehicle performs best on existing terrain.

REVERSE Use to back up vehicle.	R
NEUTRAL Disengages engine and drive train.	N
2-3 RANGE Use on level terrain where maximum speed is needed.	2-3
1-3 RANGE Use on level or hilly terrain where maximum speed is needed.	1-3
1-2 RANGE Use for rough terrain, water operation, and up or down long grades.	1-2
1 RANGE Use for rough terrain, crossing ditches, and entering or leaving water.	1

PLACING VEHICLE IN MOTION

DRIVING CAUTIONS

DON'T leave driver's compartment with engine running.
DON'T move vehicle unless suspension lockout is retracted.
DON'T drive vehicle with hand THROTTLE except in an emergency.
DON'T accelerate and decelerate rapidly.
DON'T oversteer at speeds that may cause you to lose control of vehicle.
DO be sure driver's and commander's hatch covers are locked either open or closed.
DO wear your ear plugs during vehicle operation to prevent ear damage from engine noise.
DO take it easy until you are familiar with your vehicle.

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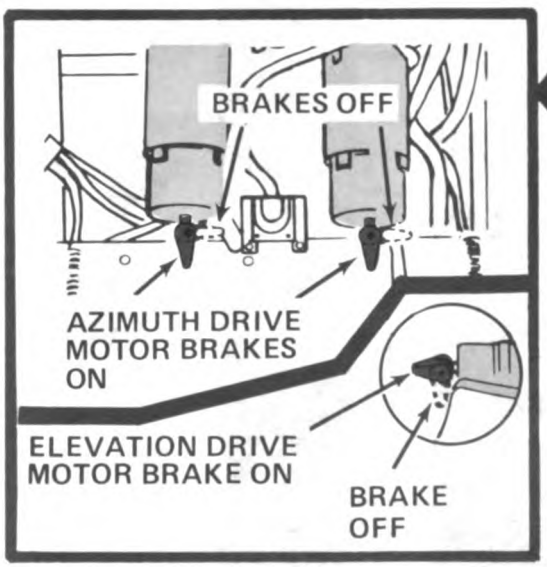
PLACING VEHICLE IN MOTION

Prepare vehicle for travel as tactical situation permits (page 2-68).

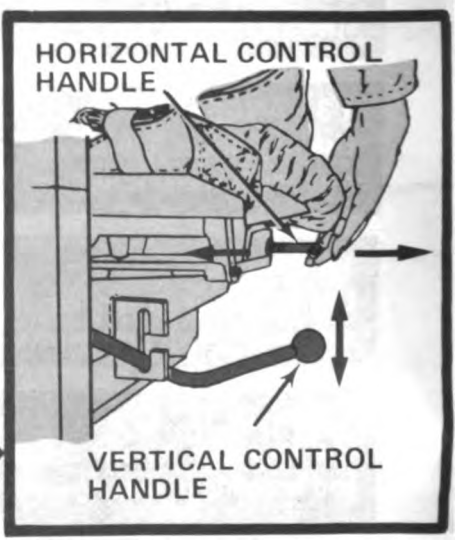
1

1. Secure cannon with travel lock.
2. Stow radar antenna.
3. Install muzzle, or turret, and antenna covers.



2

Make sure azimuth and elevation drive motor brakes are ON.



Using your body weight to hold seat, adjust driver's seat to comfortable driving position.

3

4

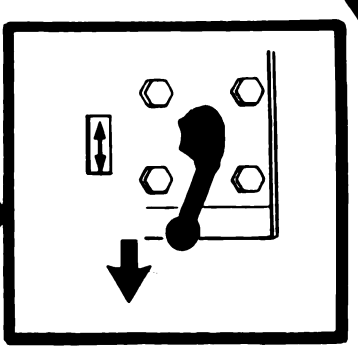
Start vehicle engine (page 2-42, 2-45, or 2-145).

Raise ramp and secure personnel door (page 2-70).

5

Assure suspension lockout handle is in RETRACT position

6



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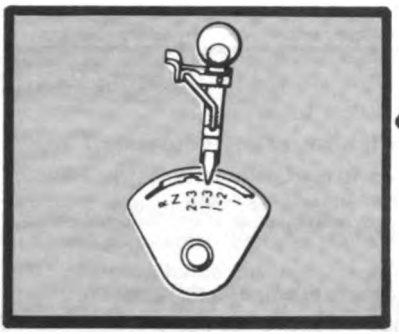
PLACING VEHICLE IN MOTION – CONTINUED



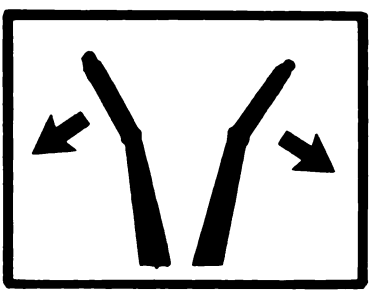
7 Determine proper transmission gear range and position range selector (page 2-55).

8

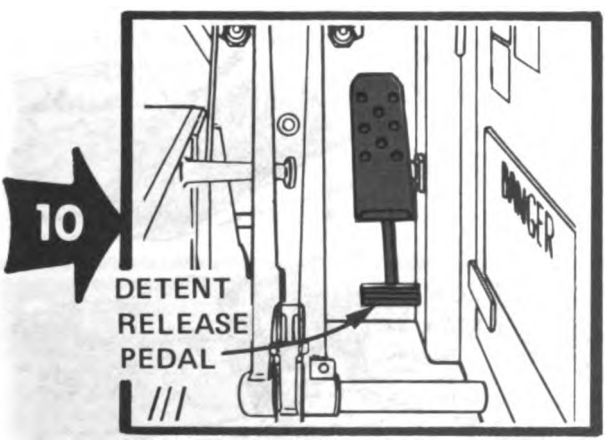
WARNING

Alert personnel before placing vehicle in motion.

9 Pull on differential steering levers to release brakes keeping thumbs clear of locking buttons, then release levers.



10



Depress accelerator pedal slowly and evenly. Control speed and direction of vehicle with accelerator pedal and differential steering levers.

IMPORTANT

If accelerator pedal is depressed through full throttle detent, transmission will remain in same gear as vehicle accelerates or will downshift to a lower gear for more power. Transmission cannot upshift until DETENT RELEASE PEDAL is depressed.

END

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DRIVING ON ROUGH AND HILLY TERRAIN

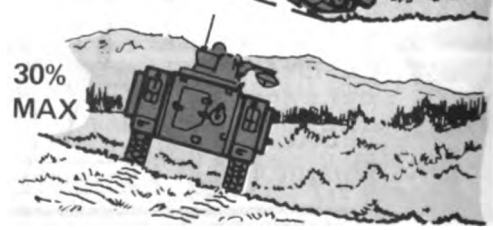
DRIVING CAUTIONS

DON'T drive on grades over 60%.
DON'T traverse sideslopes over 30%.
DON'T attempt to cross trenches and ditches over 5 1/2 feet wide.
DON'T attempt to negotiate vertical obstacles over 2 feet high.
DON'T brake if track is thrown; coast to a stop.
DO select a gear range that does not require excessive automatic shifting.
DO steer in a series of short turns when operating on sideslopes and in loose sand, dirt, or rocks.
DO downshift before starting down steep hill.
DO approach bottom of hill or ditch cautiously to avoid digging in.

- **Decelerate as vehicle approaches edge of ditch or trench. Accelerate when track contacts far side of trench. Max width of trench safely crossed is 5 1/2 feet. Use gear range 1 or 1-2.**

- **Accelerate as vehicle climbs grade. Decelerate at top of grade and during descent. Use range 1 for 30% to 60% grades and range 1-2 for up to 30% grades.**

- **Steer in a series of short turns on side slopes rather than one long even turn, to allow debris to feed out of tracks. Use gear range 1 or 1-2.**



- **Descend grades slowly. Shift to a lower range before starting down. Approach bottom cautiously to avoid digging. Use gear range 1 for 30% to 60% grades and gear range 1-2 for up to 30% grades.**

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OPERATION IN WATER

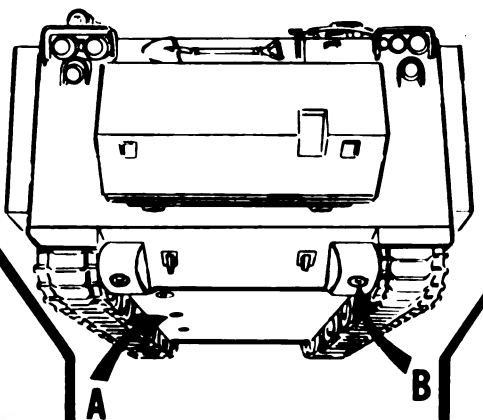
DRIVING CAUTIONS

DON'T operate vehicle in water if flotation pods or mounting flanges are damaged.
DON'T enter water with high or choppy waves (over 1 foot).
DON'T tow anything in water.
DO use pivot steer levers to maintain control of vehicle until clear of water.
DO open top hatch covers if situation permits.
DO sit on top deck if water rises above floor plates.
DO accelerate and head for nearest shore if vehicle shows signs of swamping.

VEHICLE PREPARATION

1

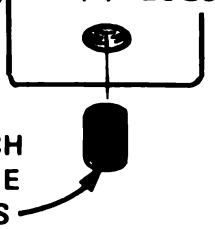
Check hull drain plugs (A & B) for tightness.



A LOCATE (3) PLUGS

VIEW FROM BOTTOM

B LOCATE (2) PLUGS

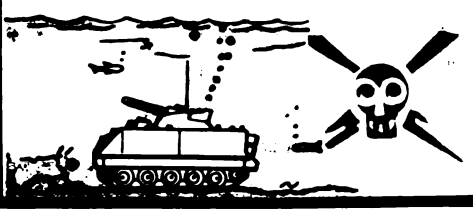


3/4 INCH SQUARE RECESS

2 Check flotation pods and mounting flanges for any signs of damage.

3 Do not operate vehicle in water if flotation pods or mounting flanges are damaged. Pods could break loose and the vehicle sink.

WARNING



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OPERATION IN WATER – CONTINUED

4 Check that basic issue items are properly stowed and tied down. (page D-1)

5 Check track shrouds for proper installation and good condition.

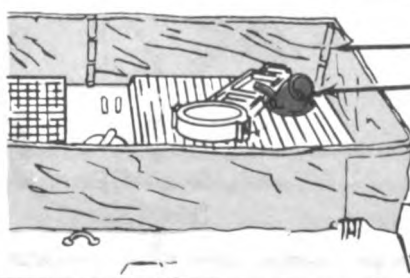
6 Position cannon over left side of vehicle

Remove air grille curtain from stowage (page D-1).

7 Position cannon over rear of vehicle if situation permits, and fully elevate cannon barrels.

Lock azimuth and elevation drive motor brakes (page 2-26).

8



Install five curtain posts.
Turn exhaust outlet so it points to rear of vehicle.
Secure travel lock in stow position.
Install air grille curtain around posts.

9 Raise and lock ramp and personnel door (page 2-70).

10 Open top hatch covers if situation permits.

11 If necessary, install M19 periscope for blackout driving with infrared headlights (page 2-136).

12 Turn on vehicle interior lights if situation permits (page 2-7).

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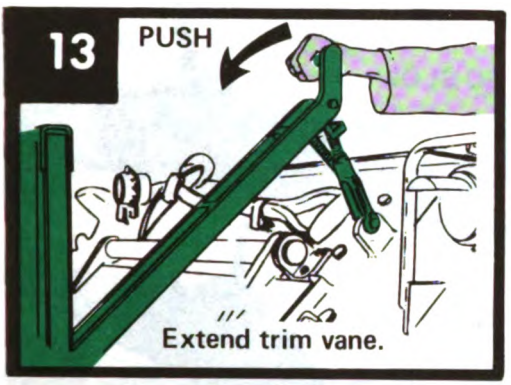
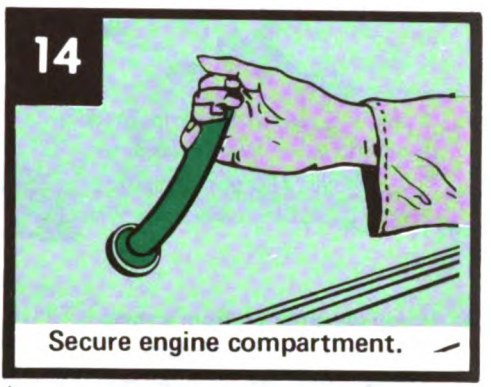
OPERATION IN WATER – CONTINUED

13



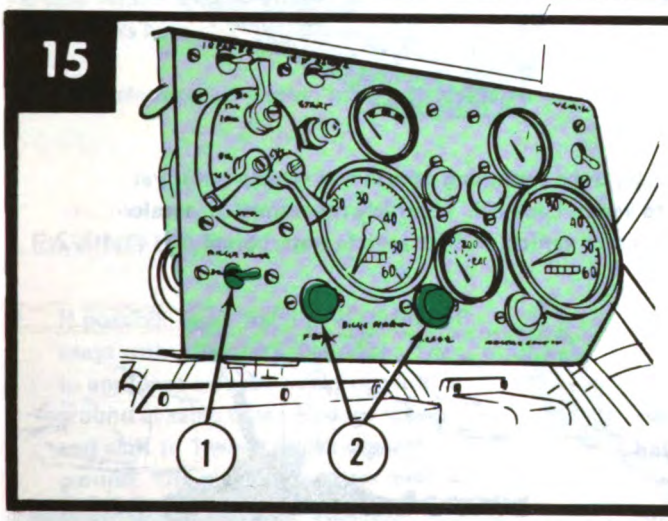
Extend trim vane.

14



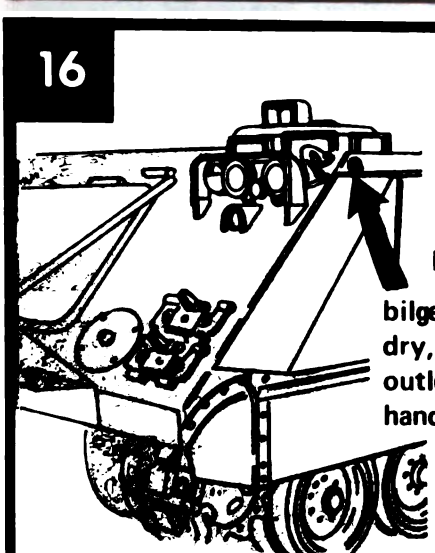
Secure engine compartment.

15

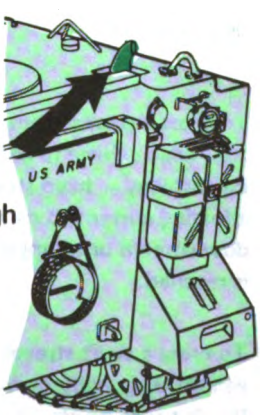


- Set BILGE PUMPS switch (1) to ON.
- BILGE PUMPS ON FRONT-REAR lights (2) should light.

16



Check for water coming out FRONT and REAR bilge outlets. If bilge is dry, air should come through outlets. Check by placing hand over outlet.



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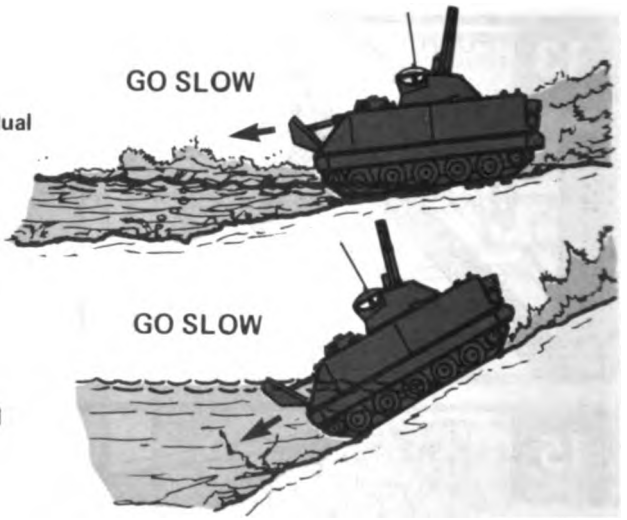
OPERATION IN WATER – CONTINUED

ENTERING WATER

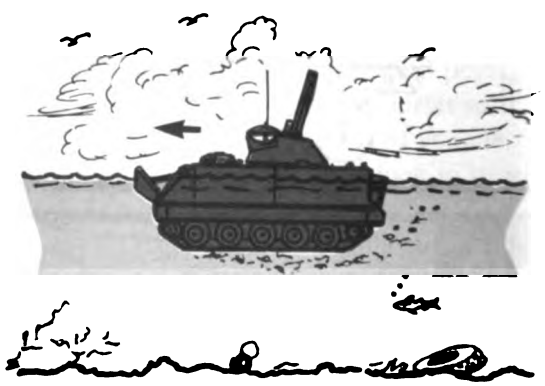


- If possible, enter from firm, gradual slope into water deep enough to float vehicle. Use gear range 1.

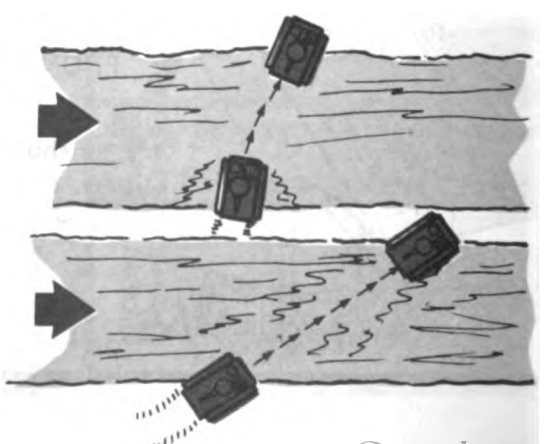
- If you are entering from a steep slope, or slope with obstacles, maintain close watch to see that water doesn't get into intake and exhaust grilles. Use gear range 1.

IMPORTANT – If water appears to be swamping vehicle and vehicle is not yet committed to water, back off. If vehicle is committed, accelerate to raise front of vehicle and get vehicle waterborne.

DRIVING IN WATER



- Steer vehicle in water as on land using pivot steer levers. Allow for much slower vehicle reaction time. When turning, release pivot steer levers before turn is complete and allow momentum of vehicle to complete turn. Use gear range 1-2.



- To cross a slow stream (2 mph or less) head vehicle in any direction. Fastest way – head straight across allowing current to carry vehicle downstream until opposite bank is reached.

- To cross a swift stream, head vehicle diagonally downstream. Don't try to go straight across.

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OPERATION IN WATER – CONTINUED

- If vehicle strikes an underwater snag, apply brakes, shift to R, back off and go around.
  IMPORTANT - Do not try to go over or through obstacles; vehicle may roll and take water or hang up.

STOPPING IN WATER

To stop vehicle in water, release accelerator padal, and pull back on both pivot steer levers. When tracks have stopped, release levers, shift to R, and depress accelerator pedal.

When vehicle forward motion has stopped, release accelerator and shift to N.

LEAVING WATER

- If possible, leave water in area clear of snags with a firm, gradual slope. Try to approach so both tracks contact ground at same time. Reduce speed and shift to 1 when tracks contact ground. Use pivot steer levers until vehicle is clear of water. Retract trim vane if situation permits. When bilge is clear of water, stop bilge pumps.

AFTER WATER OPERATION

- Remove air grille curtain and posts and stow.
- Flush all areas of vehicle with fresh water after operating in salt water.
- If tactical situation permits, perform after water operations maintenance as soon as possible (page 3-106).

END

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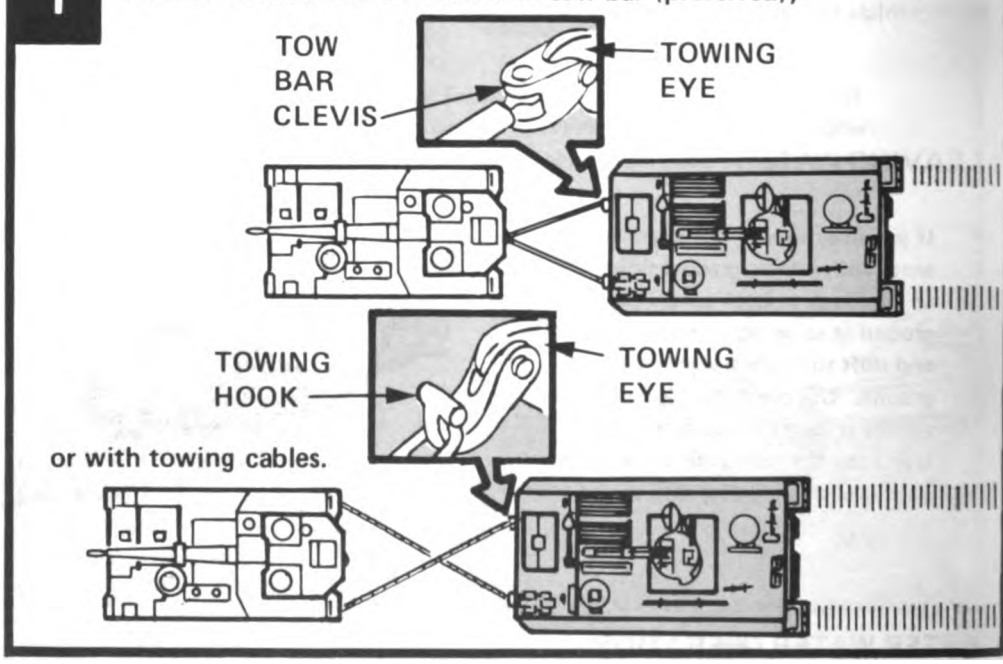
TOWING TO START ENGINE

2-6. If you cannot start the engine using normal procedures (pages 2-42, 2-45, or 2-145) notify organizational maintenance. They may decide to try tow-starting. Battalion maintenance will provide an appropriate towing vehicle.

DRIVING CAUTIONS

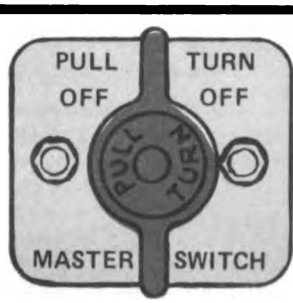
DON'T use another M163 system vehicle to tow start. Vehicle weight exceeds max towing limit.
DON'T keep towed vehicle in gear more than 10 seconds at a time when trying to start engine.
DON'T tow vehicle if suspension is locked out.
DON'T tow vehicle with ramp down.
DO use towing bar, if available, instead of towing cables.

1 Connect vehicle to be towed with tow bar (preferred),

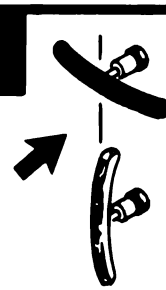


or with towing cables.

2 TURN **ON**



3



Push fuel cutoff control in.

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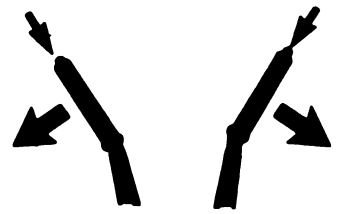
TOWING TO START ENGINE – CONTINUED

4

Shift to **N**

5



Pull on differential steering levers to release brakes keeping thumbs clear of locking buttons, then release levers.

6

IMPORTANT – Do not keep towed vehicle in gear more than 10 seconds at a time when trying to start engine.

7

When vehicle is moving at 10 - 15 mph, shift range selector to 1 - 3 range and depress accelerator halfway.

8

As soon as engine starts, shift range selector to N and signal driver of towing vehicle.

9

CAUTION – Do not let tachometer reading go over 2975 rpm at any time.

10

IMPORTANT – All indicator lights should go out within 10 seconds after engine starts. If any light stays lit, pull out fuel cutoff control to stop engine and notify organizational maintenance.

11

Set hand THROTTLE for 800 - 1000 rpm and let engine warm up 3 - 5 minutes.

12

Disconnect tow bar or towing cables.

END

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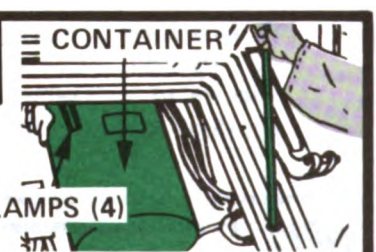
TOWING DISABLED VEHICLE

2-7. If your vehicle is disabled and requires towing, notify organizational maintenance. They will disconnect the propeller shaft (step 3 of this procedure). Battalion maintenance will do the towing.

DRIVING CAUTIONS

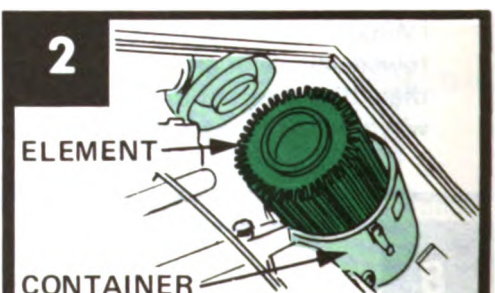
DON'T use another M163 system vehicle to tow. Vehicle weight exceeds max towing limit.
DON'T tow more than 200 feet unless propeller shaft between transmission and differential is removed.
DON'T tow vehicle if suspension is locked out.
DON'T tow vehicle with ramp down.
DON'T tow vehicle with propeller shaft still connected at one end.
DO use towing bar, if available, instead of towing cables.
DO make wide turns when towing to prevent collision.
DO notify organizational maintenance if you expect to tow more than 50 miles or over 20 mph.

1



Open engine compartment access door, and unfasten four clamps securing air cleaner. Hold air cleaner so it doesn't drop.

2

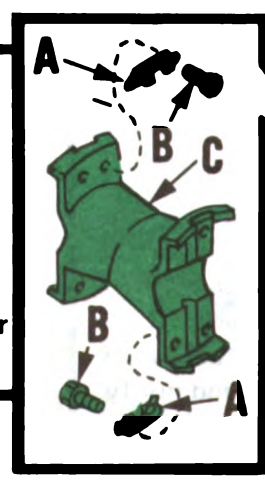


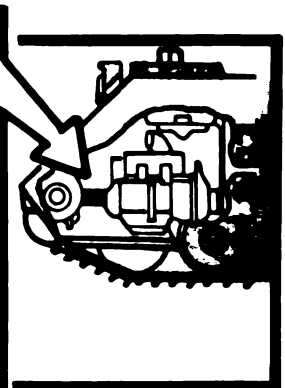
Remove air cleaner element and container.

3

Disconnect propeller shaft:

–Straighten tabs on bolt locking plates (A)
–Remove eight bolts (B), and plates
–Remove propeller shaft (C).
–Place all removed parts in container to prevent loss.





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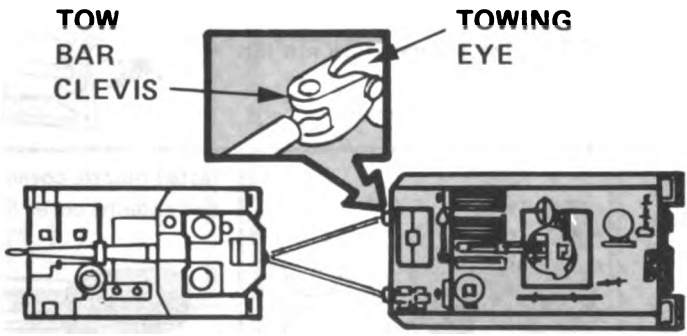
TOWING DISABLED VEHICLE – CONTINUED

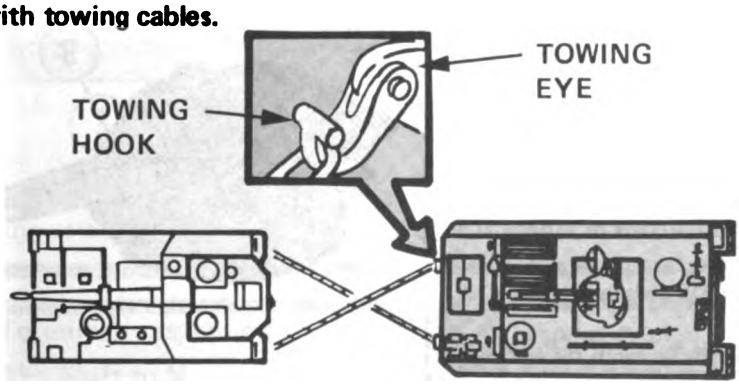
4

- Replace air cleaner element and container and secure.
- Secure engine compartment door.

5 Connect vehicle to be towed with tow bar (preferred),



or with towing cables.



END

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PREPARATION FOR TRAVEL

IMPORTANT. If you expect to fire on the move, or anticipate an attack while traveling, keep the system in a condition that allows immediate response. The system should be completely energized, and the cannon free to traverse and elevate. Before starting, perform the prefire preparations (page 2-95).

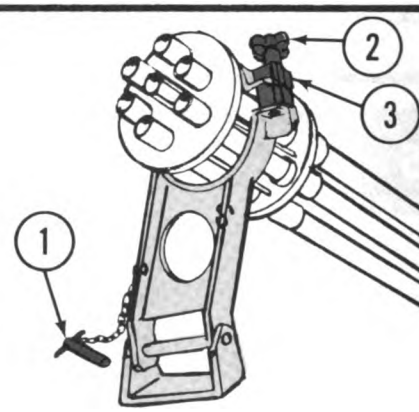
Remove pin (1), raise travel lock, and secure with pin (1).

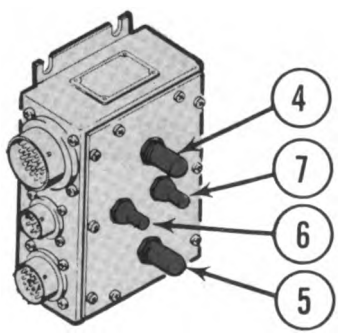
Loosen hand lock nut (2) and open clamp.

Release azimuth and elevation brakes (page 2-26), and position cannon in clamp.

Close clamp (3), and secure with lock nut (2).

Apply azimuth and elevation brakes.





On control panel, set SYSTEM POWER switch to ON.

Set MODE switch to RADAR or MANUAL.

Set stow control MODE switch (4) to STOW.

Set stow control MAINT switch (5) to ON.

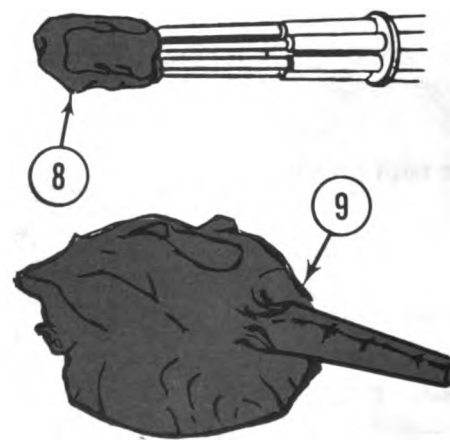
Using stow control ELEV switch (6) and TRAV switch (7), position antenna down and in.

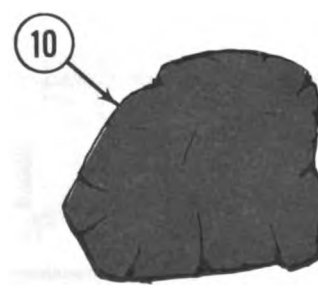
Set stow control MAINT switch (5) to OFF.

Leave stow control MODE switch (4) to STOW.

Set SYSTEM POWER switch to OFF.

Install muzzle cover (8), or turret cover (9), and antenna cover (10).





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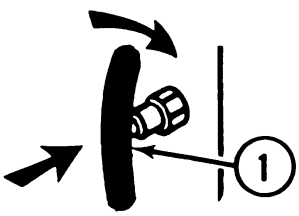
OPERATING SUSPENSION LOCKOUT

1 CAUTION – Bring vehicle to a complete stop (on level ground if possible) before operating suspension lockout.

2 Shift to **N**

3 Pull out hand THROTTLE (1) until engine runs at 1500 rpm. Lock THROTTLE, or use FOOT THROTTLE.



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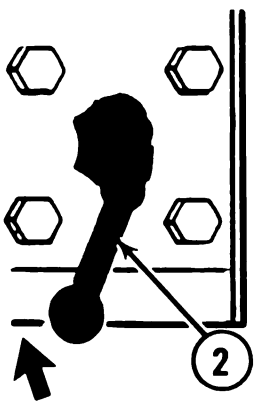

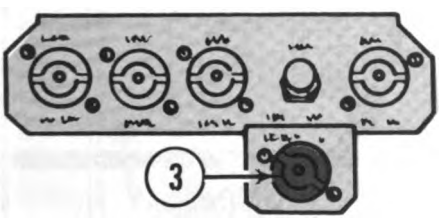

Engine can be turned off or left running after lockout.

To lock suspension, move handle (2) to EXTEND. SUSP LOCKED OUT light (3) should light.

5 To unlock suspension –

A. Shift to N.

B. Pull out HAND THROTTLE (1), or FOOT THROTTLE until engine runs at 1500 rpm.

C. Move handle (2) to RETRACT. SUSP LOCKED OUT light (3) should go out.

6 IMPORTANT – Wait at least 20 seconds after SUSP LOCKED OUT light (3) goes out before moving vehicle. Handle (2) must be in RETRACT (right) position at all times except when you want to lock the suspension.

END

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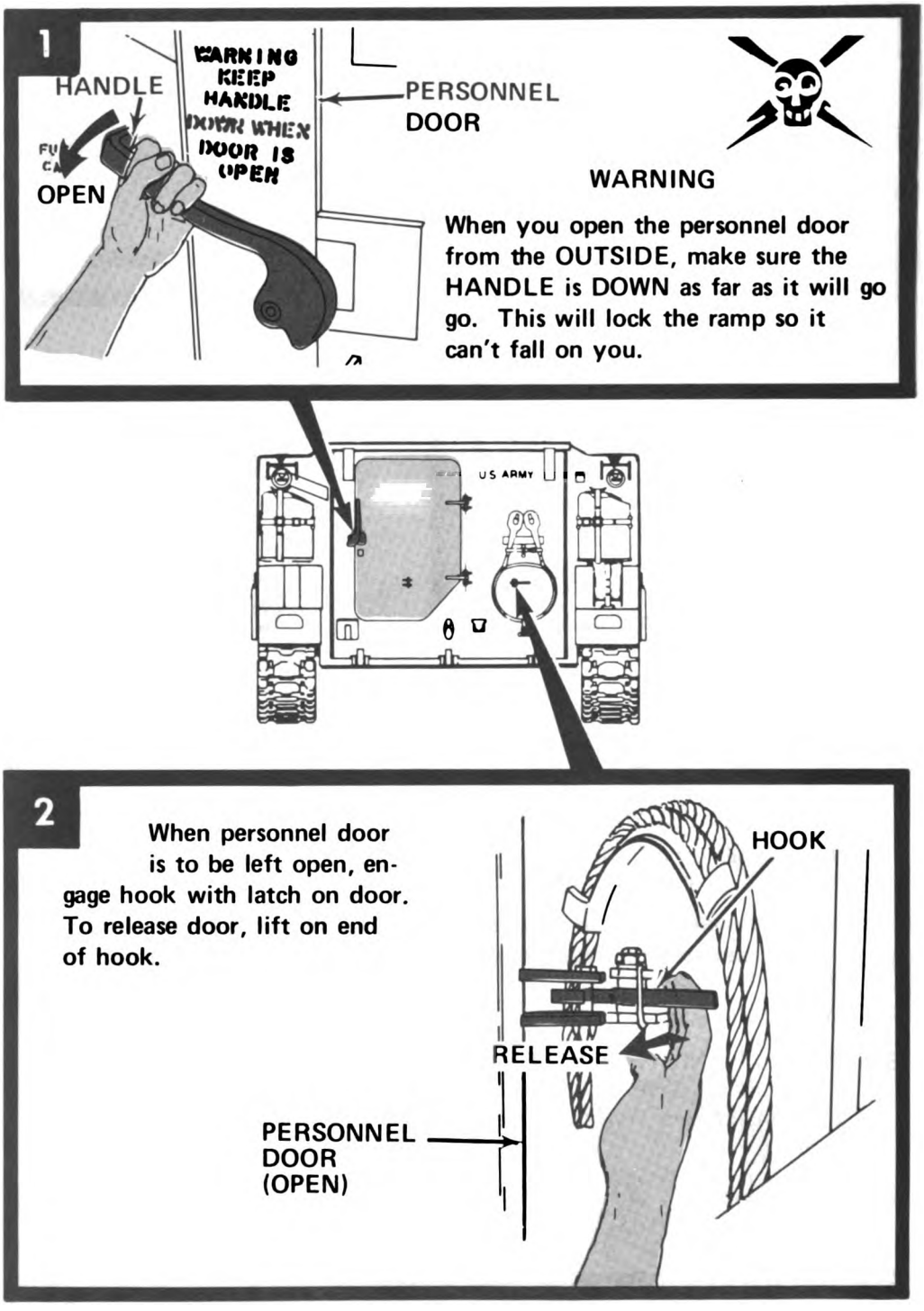
OPERATING PERSONNEL DOOR AND RAMP



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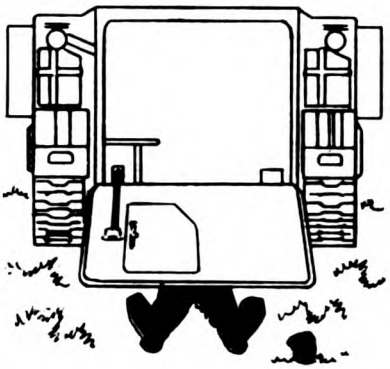
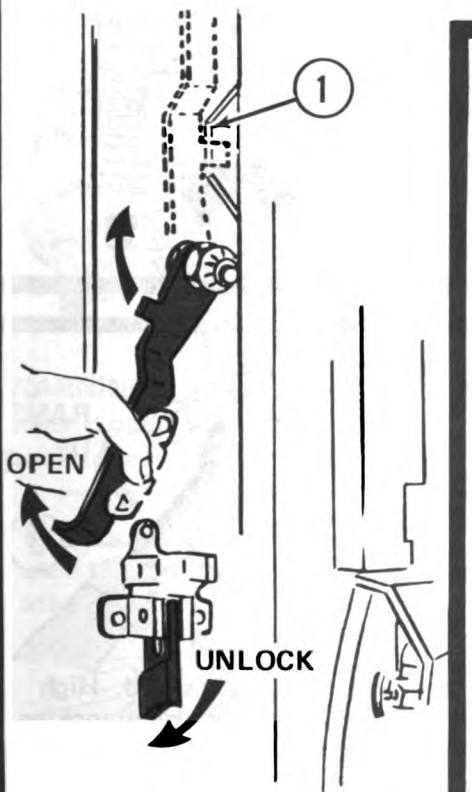
OPERATING PERSONNEL DOOR AND RAMP – CONTINUED

3

WARNING

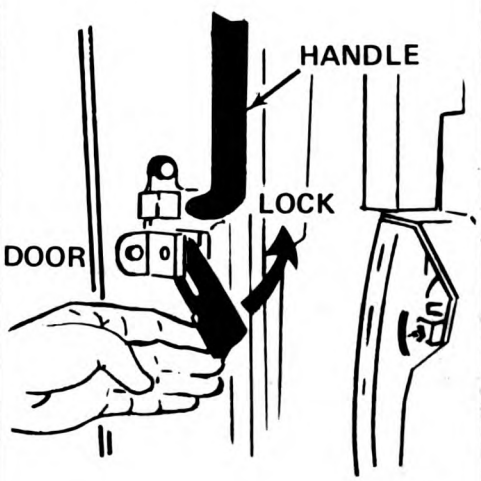
When you open the personnel door from the INSIDE, make sure the HANDLE is UP as far as it will go. Boss on handle should overlap boss on chassis (1). This will lock ramp so it can't fall on you.





4

When inside combat lock is locked, the personnel door can't be opened from outside.



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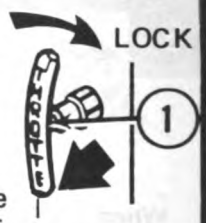
OPERATING PERSONNEL DOOR AND RAMP – CONTINUED

5 Start engine (page 2-42, 2-45, or 2-145).

6 Pull out hand THROTTLE (1) until engine runs at 1500 rpm. Lock THROTTLE, or use FOOT THROTTLE.



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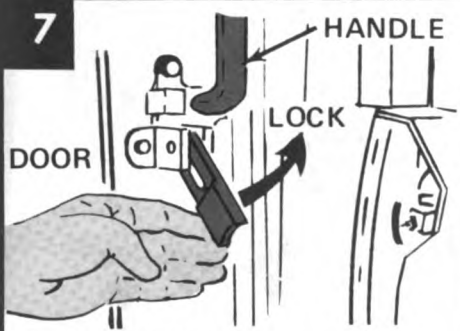
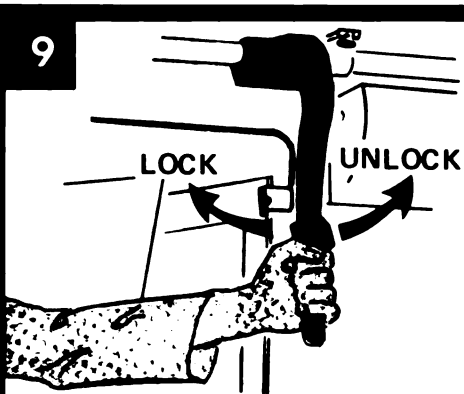


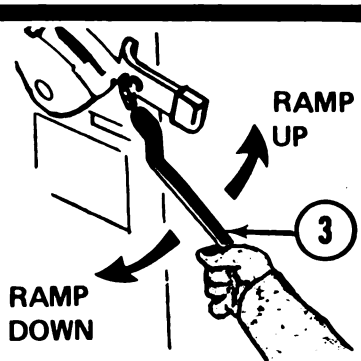
IMPORTANT – Close and lock personnel door before operating ramp.

8 **WARNING – Alert all personnel in and around the vehicle before raising or lowering the ramp.**

9



Unlock ramp locking handle (2) before operating the ramp.



10 **Operate ramp with lever (3). Move ramp at a steady speed. High speed operation and sudden stop will damage cables. Return ramp locking handle (2) to lock position after ramp has been raised or lowered. Unlock and push in hand THROTTLE (1), or release FOOT THROTTLE.**

END

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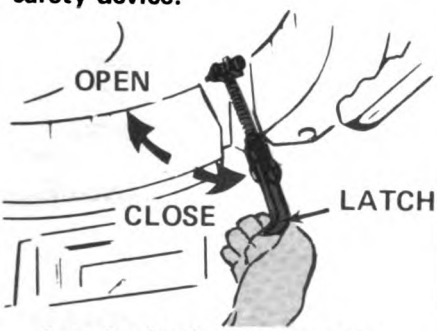
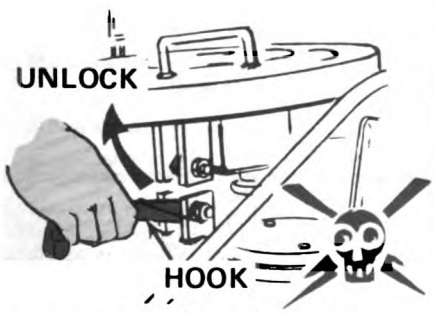
OPERATING HATCH COVER

DRIVER'S HATCH COVER has three operating controls and one safety device.



Interior latch secures cover closed from inside vehicle.

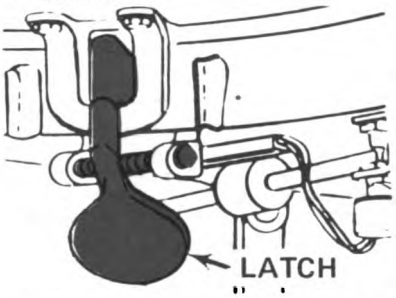
Exterior hold - open hook holds cover open and away from the driver's head during operations.



WARNING — When driver's hatch cover is open, secure cover with hook to prevent injury to driver.

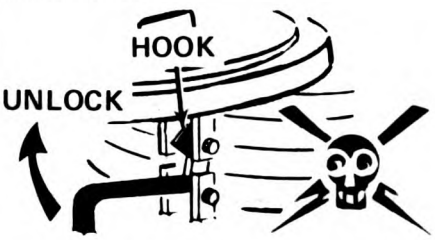
Exterior hold - closed latch is used to hold hatch cover closed after driver gets out of vehicle.

COMMANDER'S HATCH COVER has two operating controls and one safety device.



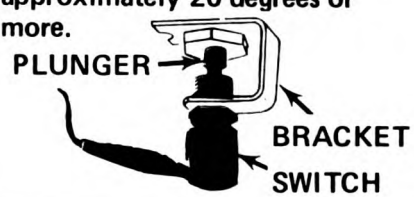
Interior latch secures cover closed from inside vehicle.

Exterior hold - open hook holds cover open and away from the commander's head during operations.



WARNING — When commander's hatch cover is open, secure cover with hook to prevent injury to commander.

Hatch safety switch prevents cannon from moving over an open driver's and commander's hatch unless cannon is elevated approximately 20 degrees or more.



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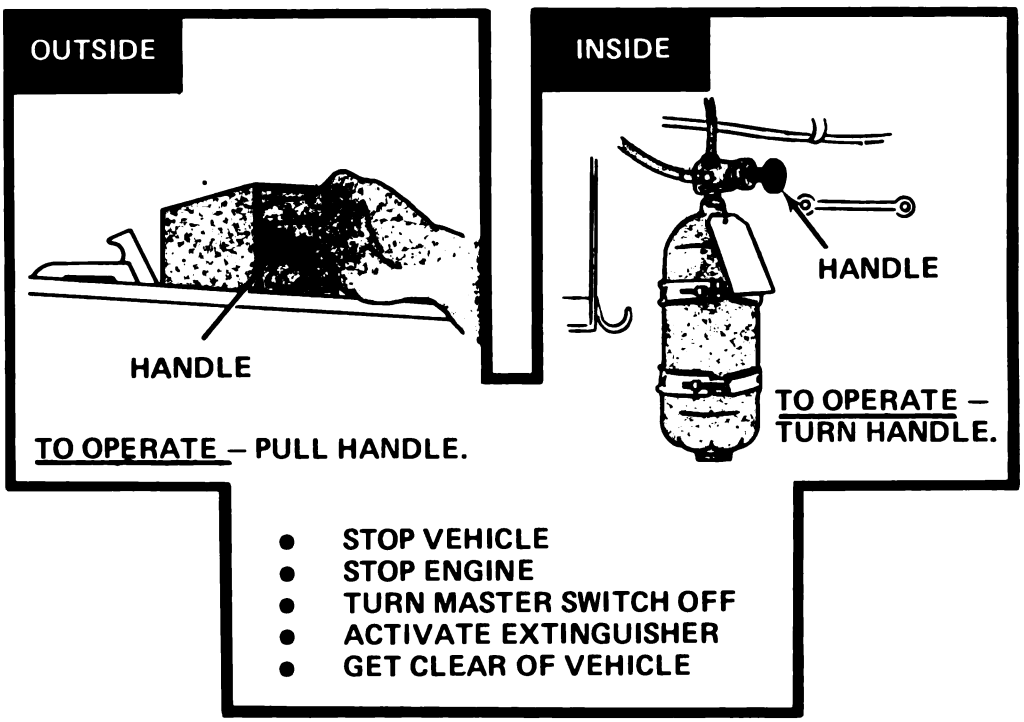
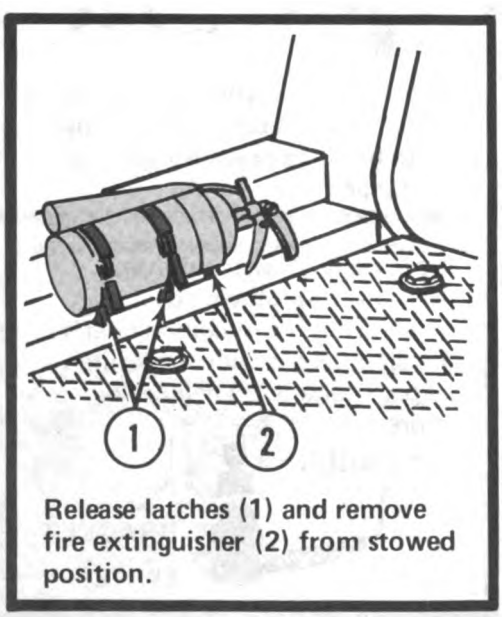
OPERATING FIRE EXTINGUISHERS

FIXED FIRE EXTINGUISHER



PORTABLE FIRE EXTINGUISHER



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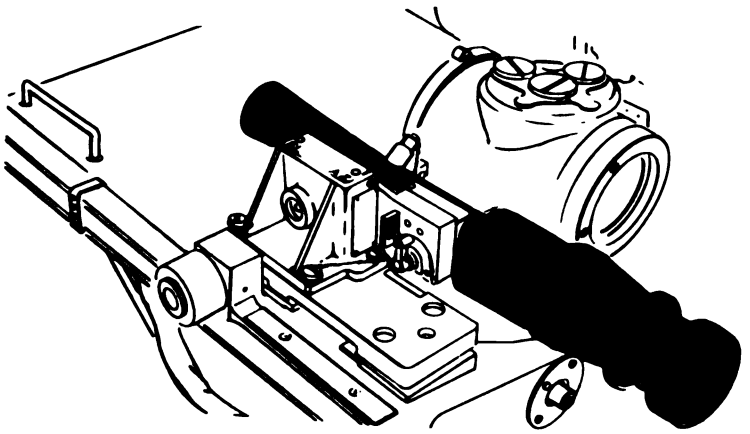
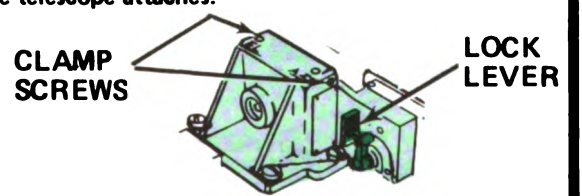
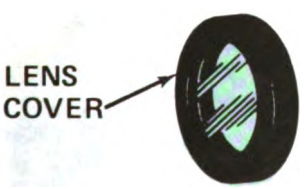
M134 TELESCOPE AND M164 MOUNT



INSTALLATION

1. Check that mount is clean where the telescope attaches.
2. Loosen clamp screws.
3. Raise lock lever to up detent.
4. Align scope and mount and push scope forward to stop. Move lock lever to down detent.
5. Remove lens cover (pull off).
6. Align gun by training the M61 sight at a distant aiming point.





7. Adjust azimuth and elevation screws to align telescope on distant aiming point. Tighten clamp screws and install lens cover (push on).
8. Boresight according to page 3-37.

REMOVAL

CAUTION

Make certain that both telescope and case are completely dry before storing telescope in case.

1. Raise lock lever.
2. Slide telescope rearward off mount.
3. Check that lens cover is installed and store telescope in case.

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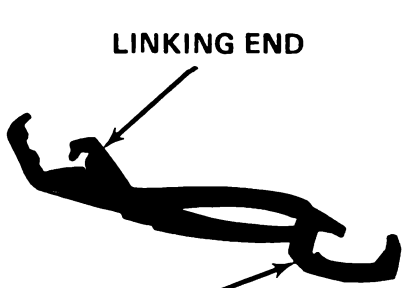
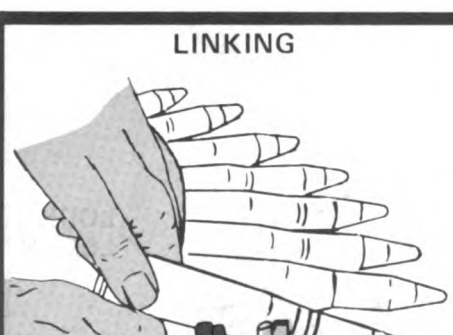
OPERATING LINKER–DELINKER

WARNING

Electrically primed ammunition can fire if exposed to high-power radio frequency fields. Avoid contact of any kind with primer, especially with metal objects. See TM 9-1300-200 for detailed ammunition handling instructions. Rechambering of live ammunition is prohibited.



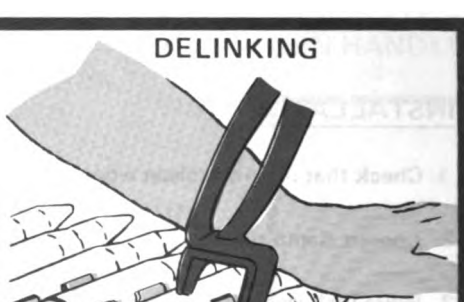
LINKING



- Insert round in link.

- Clamp round into link. Make sure link tabs engage extractor groove.

DELINKING



- Insert tip of tool between round and link flange.

- Pull tool down to release round

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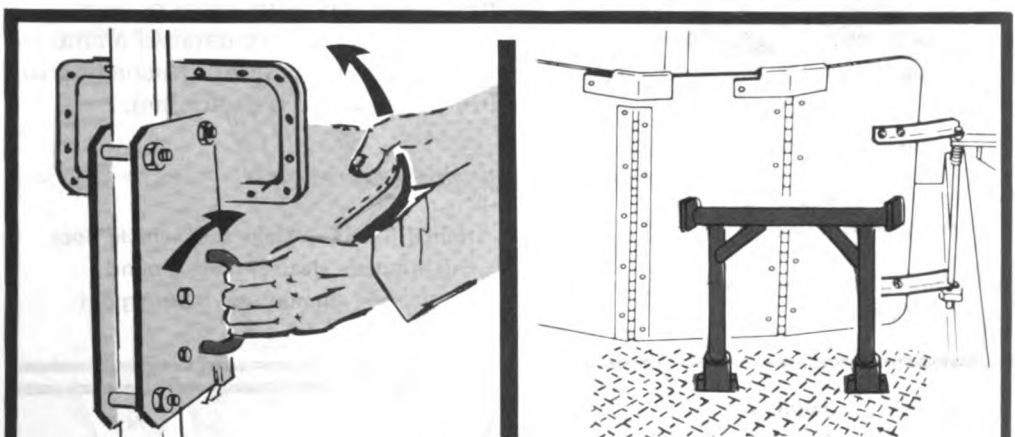
AMMUNITION STORAGE SYSTEM

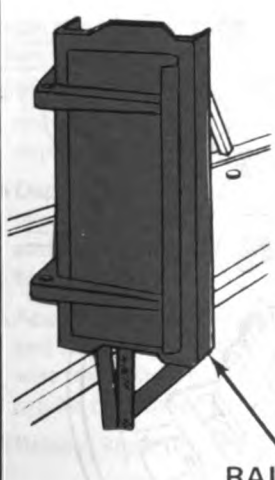
PREPARING TO LOAD

- ▲ Check that nothing will interfere with turret movement.
- ▲ Remove turret cover if installed.
- ▲ Release cannon from travel lock and stow the lock.
- ▲ Release azimuth and elevation drive motor brakes (page 2-26) and manually position the mount so that radar antenna mounting bracket points to travel lock. Cannon elevation should be approximately 0 degree. Set azimuth and elevation drive motor brakes on.

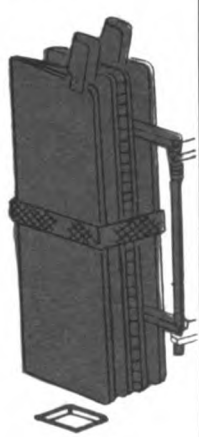


Turn handle, fold up commander's seat — and — remove commander's footrest.

FOLD GUARD



- ▲ Fold turret guard against right wall and secure with web strap.
- ▲ Lower personnel seat backrest (only if ammo in rack is to be loaded).
- ▲ Release front web strap and swing seat up toward ramp (only if ammo in rack is to be loaded).



RAISE SEAT

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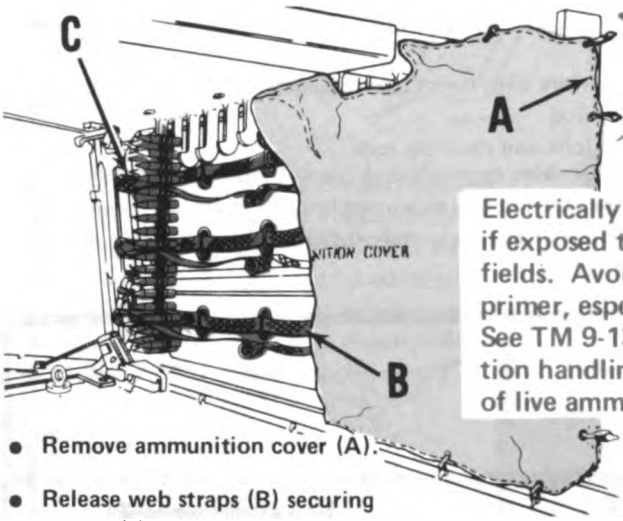
PREPARING TO LOAD – CONTINUED



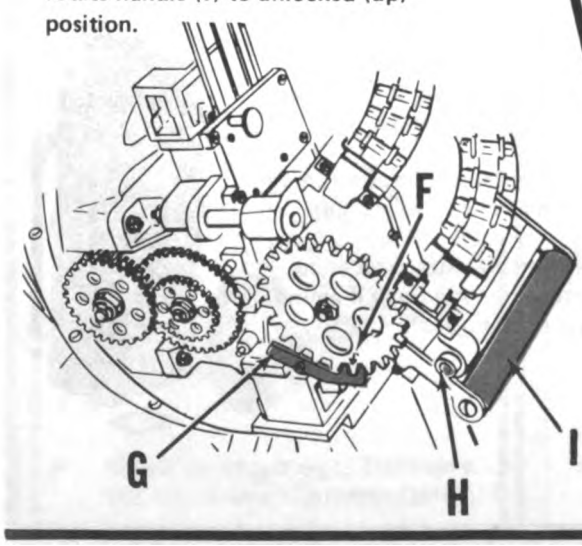
WARNING

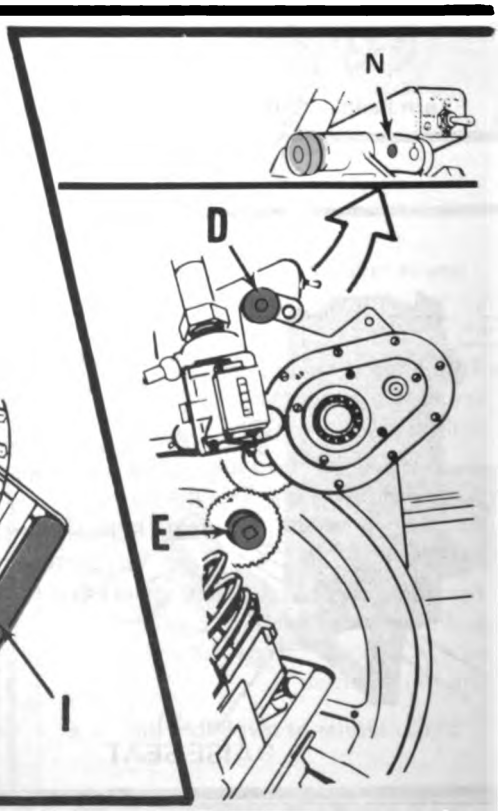
Electrically primed ammunition can fire if exposed to high-power radio frequency fields. Avoid contact of any kind with primer, especially with metal objects. See TM 9-1300-200 for detailed ammunition handling instructions. Rechambering of live ammunition is prohibited.

- Remove ammunition cover (A).
- Release web straps (B) securing ammunition to wall.
- Remove ammunition starting at ramp end of rack (C).

IMPORTANT – Make sure vehicle floor and ramp are clean and use ground cover when ammunition is strung outside vehicle.

- Set shift pin handle (D) to N.
- Rotate knob (E) clockwise until index arrow (F) is opposite notch in timing lock (G).
- Depress handle lockbutton (H) and rotate handle (I) to unlocked (up) position.





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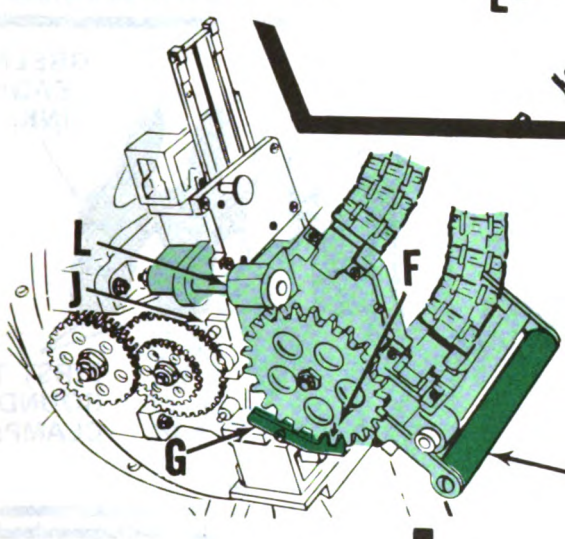
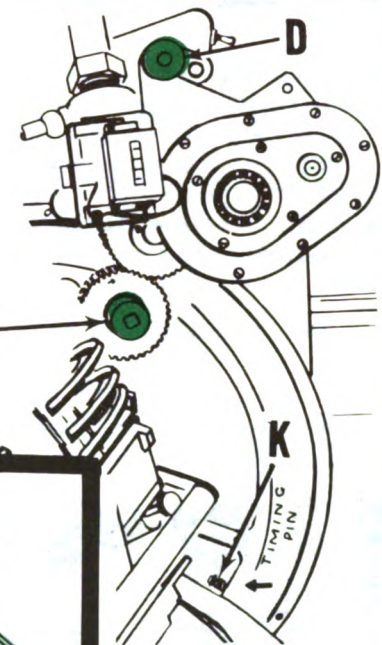
PREPARING TO LOAD – CONTINUED

- ▲ Pull conveyor unit (L) out from exit unit to load position.
- ▲ Unlock handle (I) and rotate down (lock).
- ▲ Check that timing lock (G) notch has engaged an indexed tooth (F). If not indexed, rotate conveyor gear to align G and F.
- ▲ Conveyor is now in load position.





Preparation for loading partially filled drum.

- ▲ Turn knob (E) counterclockwise until round positioning pin (J) can be depressed.
- ▲ Depress pin (J). Turn knob (E) clockwise until round is against pin (J). Apply and maintain slight pressure on knob (E) to hold pin (J) in.
- ▲ Apply pressure to drum timing pin (K) and slowly turn knob (E) counterclockwise until pin (J) is released and pin (K) can be depressed.
- ▲ Release knob (E), then pin (K).

Preparation for loading completely empty drum.

- ▲ Rotate knob (E) clockwise until timing mark on scoop disc is aligned with timing marks on exit cover.

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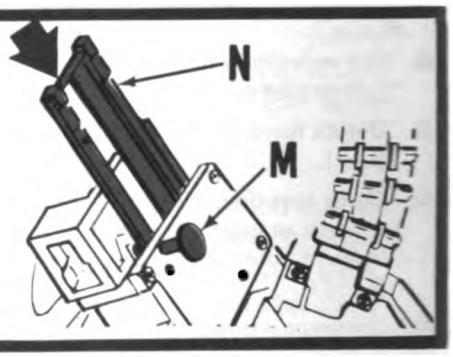
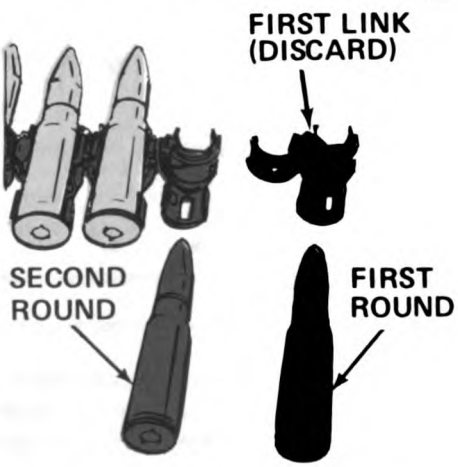
PREPARING TO LOAD – CONTINUED

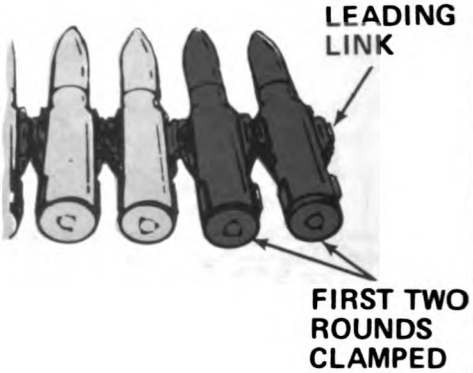
▲ Momentarily pull out locking pin (M) and push down double link stripping guide (N) until locking pin engages with upper hole in stripping guide (load position).



CAUTION

Do not use dummy ammo.





▲ Remove first two rounds with M25 delinker tool (page 2-76). Remove and discard first link.

▲ Replace first link with green leading link. Clamp first two rounds in place with M25 linker tool.

IMPORTANT - Make sure vehicle floor and ramp are clean and use ground cover when ammunition is strung outside vehicle.

▲ Check that all rounds in belts are correctly linked. After all rounds are checked for correct linking, lay out ammunition belts so that open side of links are down.

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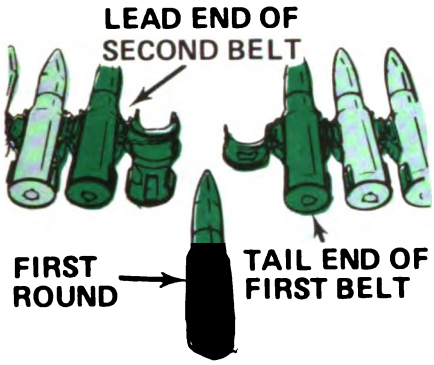
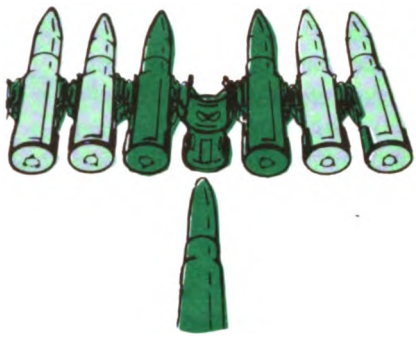
PREPARING TO LOAD – CONTINUED

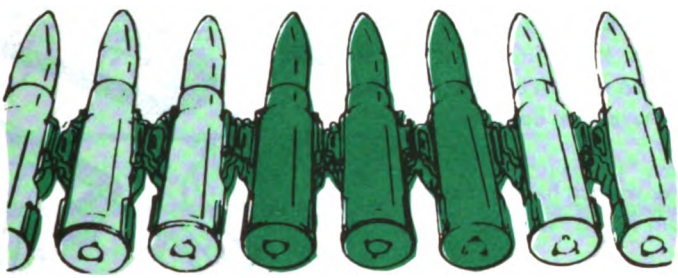
▲ Splice ammunition belts.



▲ With M25 delinker, remove first round from lead end of second belt (page 2-76).

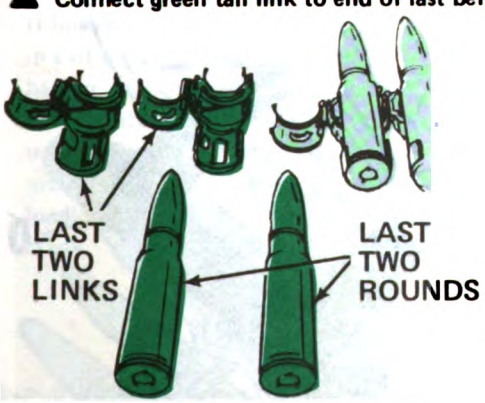


▲ Join lead end of second belt to tail end of first belt.

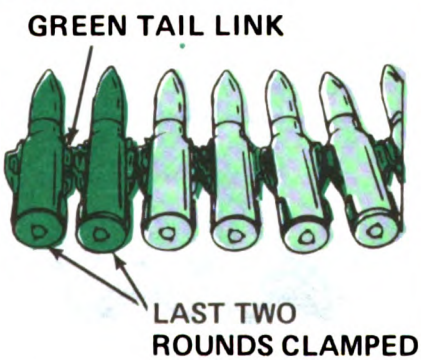


With M25 linker clamp round in link .

▲ Connect green tail link to end of last belt to be loaded.



▲ Remove last two rounds with M25 delinker tool. Remove last two links and discard one.



▲ Replace last link with green tail link. Clamp last two rounds in place with M25 linker tool .

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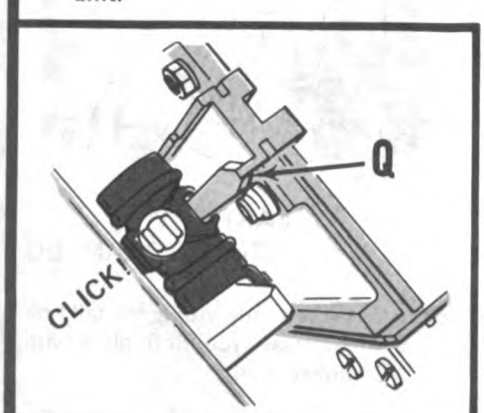
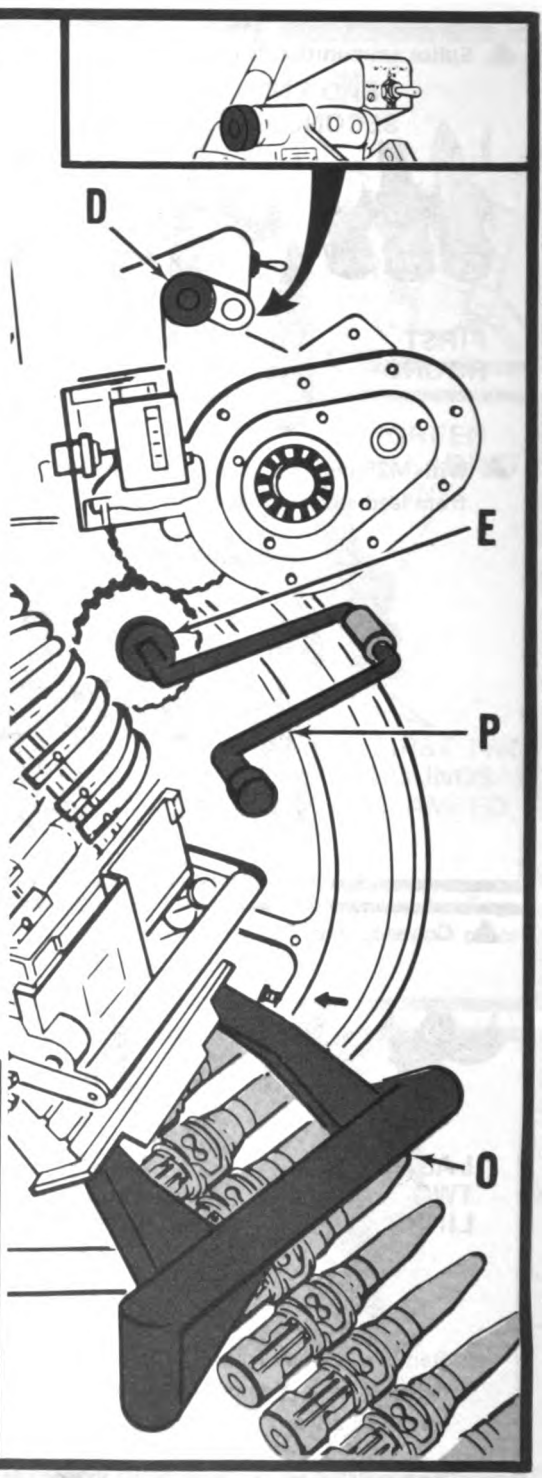
LOADING

- Feed first round into load chute (O), open side of link down, projectiles toward drum.
- Continue to feed ammunition into chute until first round enters exit unit and sprocket. Knob (E) will turn slightly counterclockwise. Visually check that first round is in position.
- Insert speed wrench handle (P) into takeoff gear knob (E) and slowly turn wrench counterclockwise until leading link engages "T" rail guide (Q). Approximately 1/4 turn is required to engage leading link, and a click will be heard when it engages.
- Turn speed wrench handle until two rounds have been delinked.
- Remove wrench handle and set shift pin (D) to "L" position.
- If shift pin does not engage, rotate takeoff gear knob (E) slightly clockwise until pin (D) can be engaged.
- Place container for links under exit unit.





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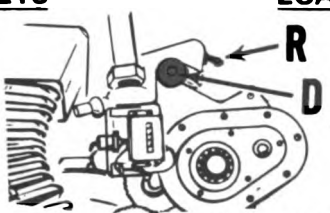
LOADING – CONTINUED

LOADING SHORT BELTS



▲ Momentarily hold load switch (R) to MOMENTARY ON (up) position. Release switch before last round enters load chute. Recover leading link.

▲ Splice new belt to end of belt being loaded (page 2-81). Check belt for correct linking.

▲ Continue loading and splicing until drum is loaded. Loading motor will shut off automatically when drum is full.

LOADING LONG BELTS

▲ Momentarily hold load switch (R) to MOMENTARY ON (up) position. Release switch after 5 to 10 rounds have been loaded to check for free flow of ammunition. Recover leading link.

▲ Set load switch to ON (down) position.

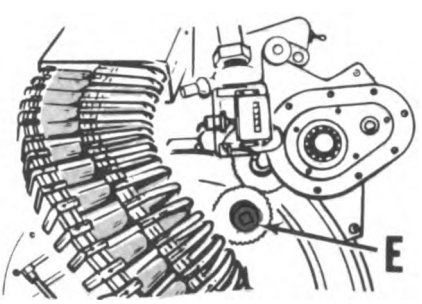
▲ Continuously check for free flow of ammunition into loading chute. Loading motor will shut off automatically when drum is full.

▲ Set load switch (R) to off (center position).

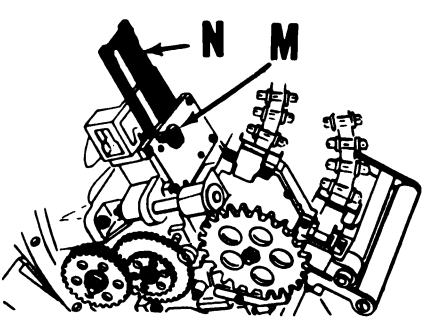
▲ After drum is loaded, set drum drive shift pin handle (D) to "N" position.

▲ Remove remaining links from exit unit. Recover tail link. Remove and dispose of stripped links.

▲ If linked ammunition remains in exit unit, insert speed wrench handle into takeoff gear knob (E). Rotate slowly clockwise until remaining linked ammunition can be removed from loading chute. Remove handcrank.



▲ Pull out locking pin (M) and pull double link stripping guide (N) until guide is fully out and locking pin is engaged.



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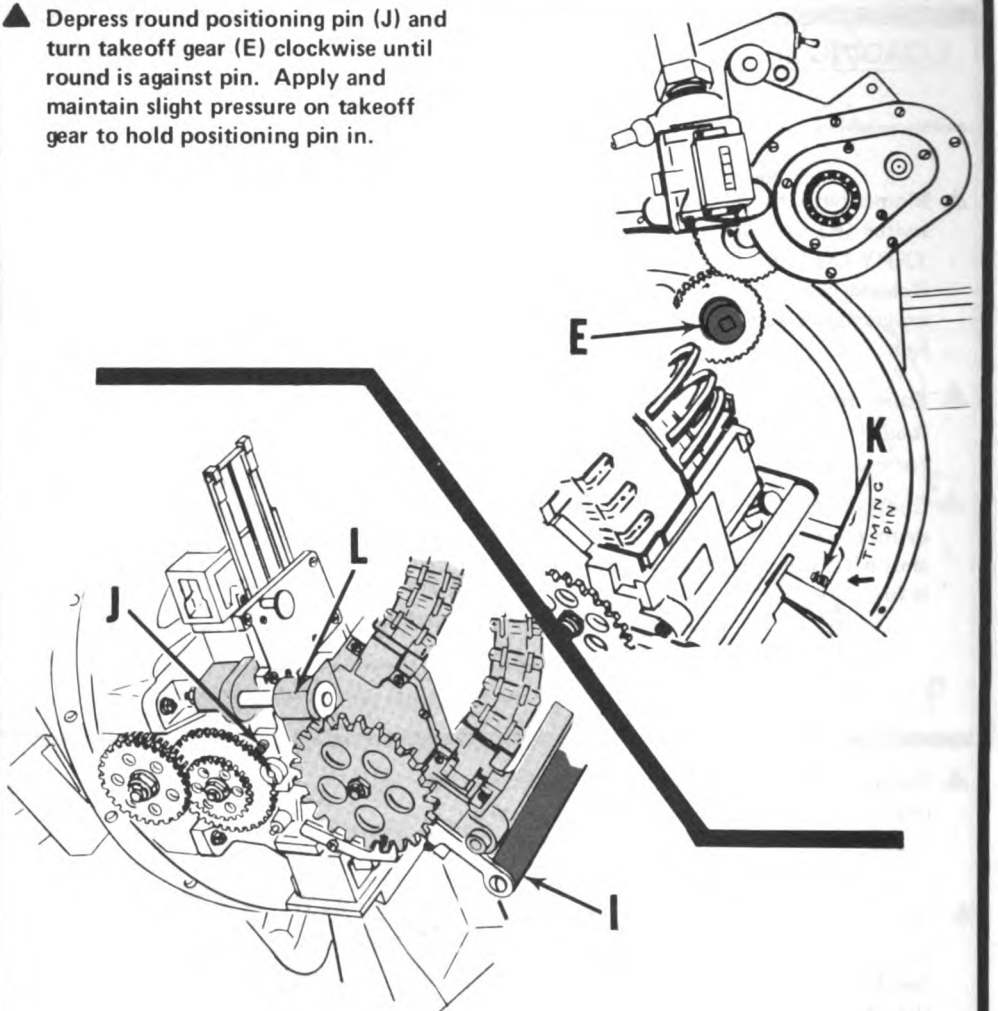
LOADING – CONTINUED

▲ Depress round positioning pin (J) and turn takeoff gear (E) clockwise until round is against pin. Apply and maintain slight pressure on takeoff gear to hold positioning pin in.



▲ Apply pressure to drum timing pin (K) and slowly turn takeoff gear (E) counterclockwise until round positioning pin (J) is released and timing pin (K) can be depressed. Release takeoff gear knob, then timing pin. Assure that timing pin (K) is released.

▲ Unlock handle (I) and rotate (up) to unlock conveyor.

▲ Push conveyor unit (L) in.

▲ Unlock handle (I) and rotate (down) to lock conveyor. Conveyor is now in fire position.

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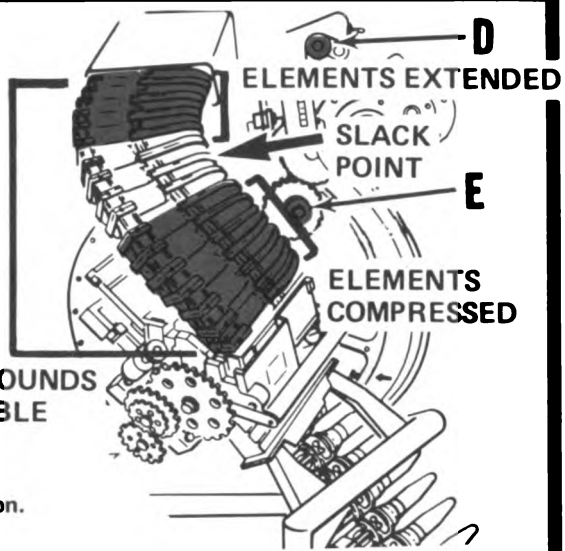
LOADING – CONTINUED

▲Check for correct slack point. When slack point is positioned correctly, 12 complete rounds are visible in feed chute. Elements above slack point are extended while elements below slack point are compressed.

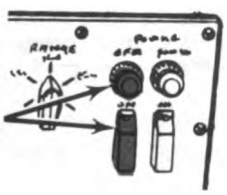
NOTE – Cannon elevation should be approximately 0 degree when checking or adjusting slack point.

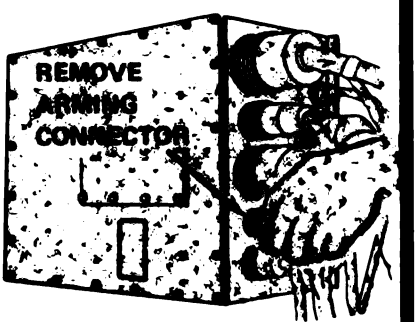


▲If slack point is positioned correctly, set shift pin handle (D) to "F" position.

▲If more than 12 rounds visible (high slack point):

GUN POWER switch OFF and indicator not lit.



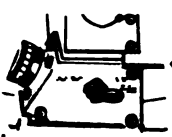


CAUTION – Don't hold switch in CLEAR AND BRAKE position longer than 10 seconds during any 1 minute interval. Do not release switch until barrel cluster has stopped rotating.

Hold to BRAKE and rotate cannon in fire direction until slack point is in proper position, then release switch.

Set shift pin (D) to "F" position.

Hold to CLEAR AND BRAKE rotate cannon to clear all rounds then release switch.



▲If less than 12 rounds visible (low slack point):

Rotate takeoff gear (E) clockwise (adding rounds to feed chute) until slack point is positioned properly.

Set shift pin (D) to "F" position.

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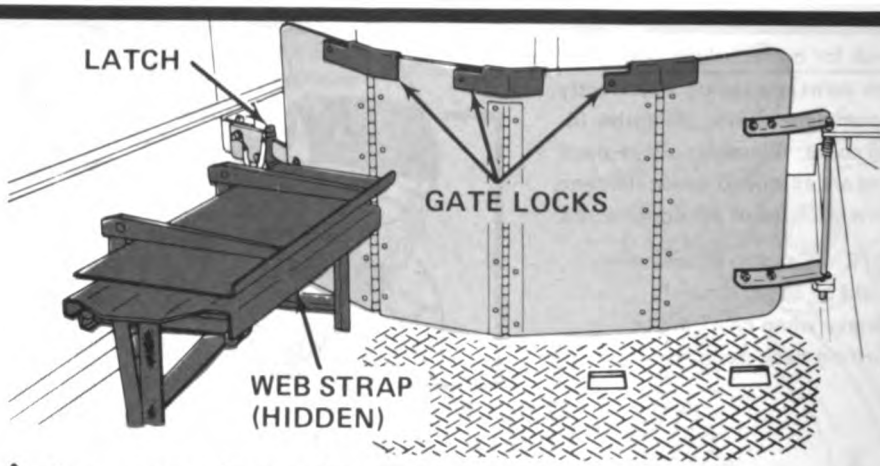
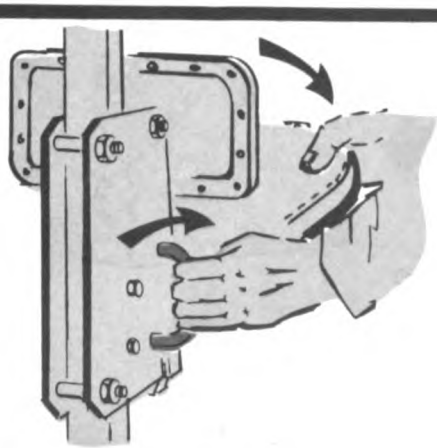
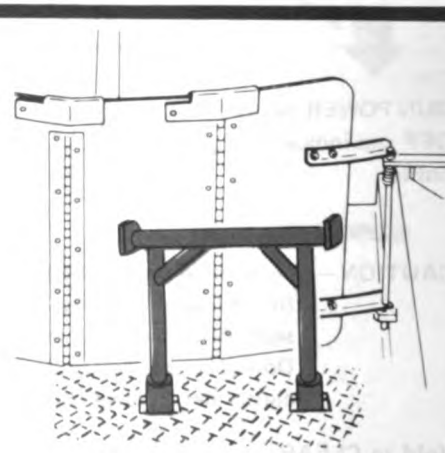
LOADING – CONTINUED



▲ Lower personnel seat and secure with web strap.

▲ Unfold turret safety guard and latch to left wall. Engage 3 gate locks on top of guard.

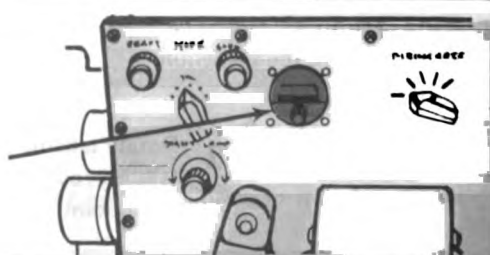




▲ Turn handle, lower commander's seat, and install commander's footrest.

▲ Stow green leading and tail links

▲ Set ROUNDS REMAINING indicator on control assembly to indicate quantity of ammunition in drum.



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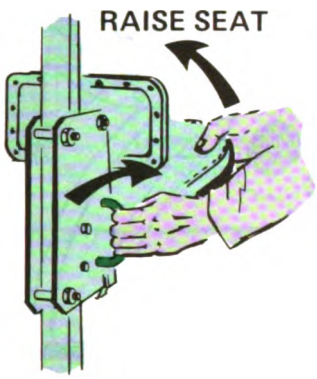
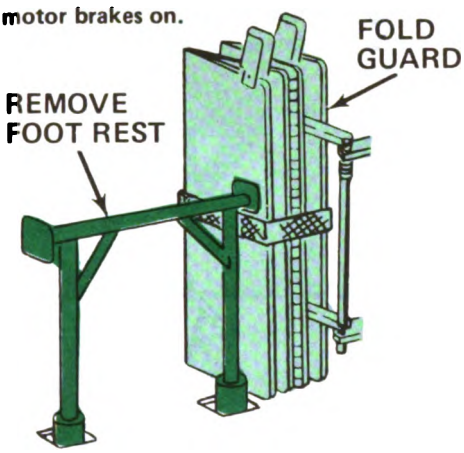
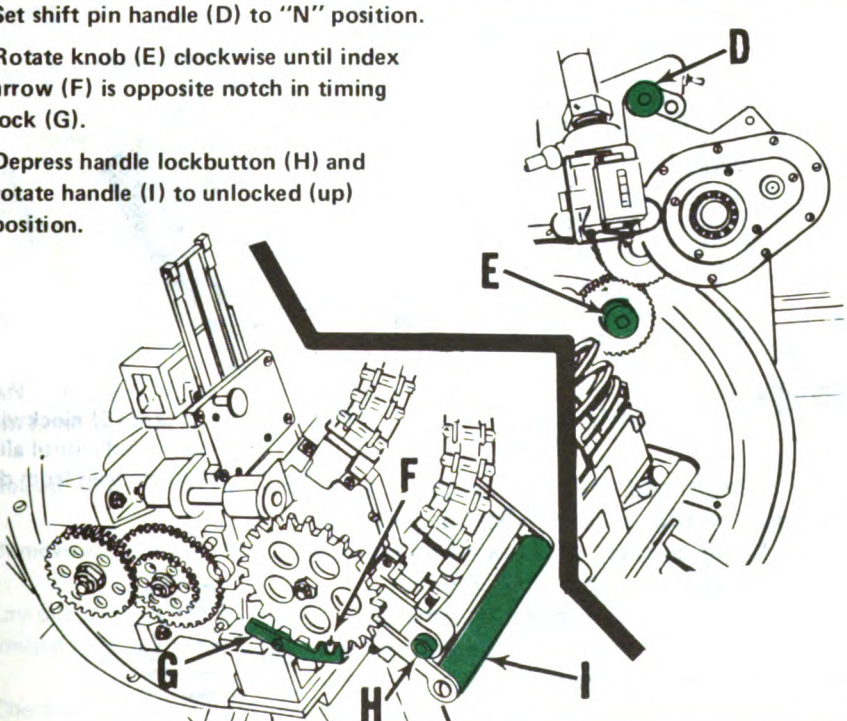
UNLOADING AMMUNITION FROM DRUM

- ▲ Check that nothing will interfere with mount movement.
- ▲ Remove turret cover if installed.
- ▲ Release cannon from travel lock and stow the lock.
- ▲ Release azimuth and elevation drive motor brakes (page 2-26) and manually position the mount so that radar antenna mounting bracket points to travel lock. Set azimuth and elevation drive motor brakes on.





- ▲ Set shift pin handle (D) to "N" position.
- ▲ Rotate knob (E) clockwise until index arrow (F) is opposite notch in timing lock (G).
- ▲ Depress handle lockbutton (H) and rotate handle (I) to unlocked (up) position.



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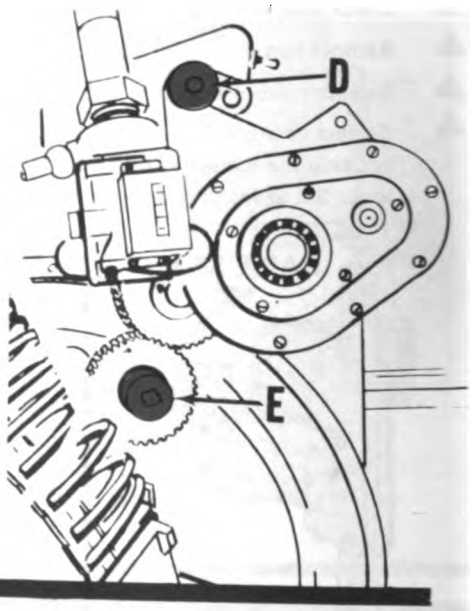
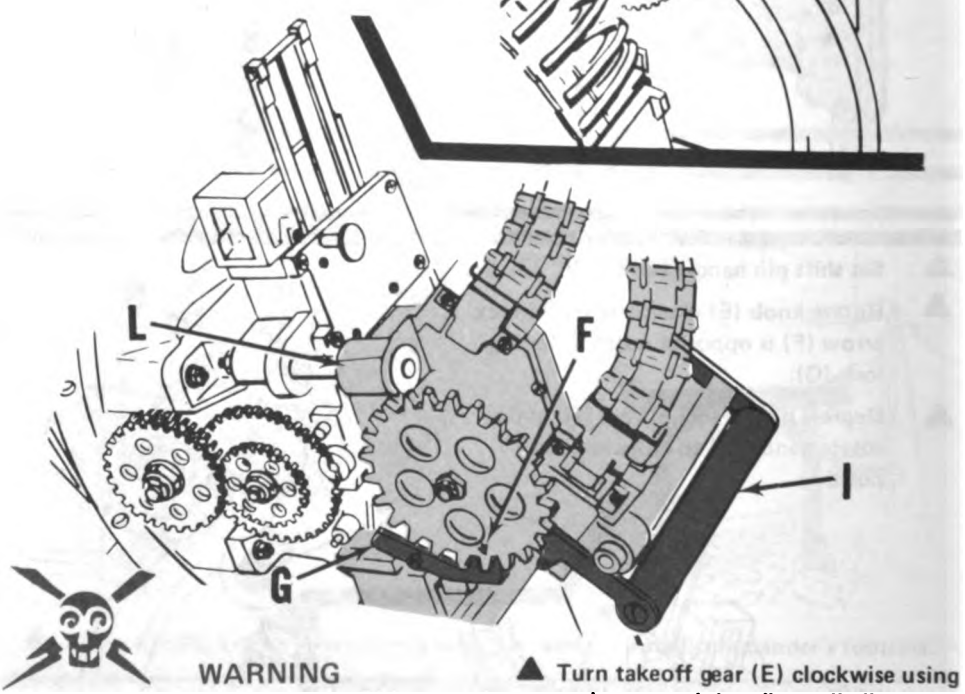
UNLOADING AMMUNITION FROM DRUM – CONTINUED

- ▲ Pull conveyor unit (L) out from exit unit to unload position.
- ▲ Unlock handle (I) and rotate down (lock).
- ▲ Check that timing lock (G) notch has engaged an indexed tooth (F). If not indexed, rotate conveyor gear to align G and F.
- ▲ Conveyor is now in unload position.





WARNING

Electrically primed ammunition can fire if exposed to high-power radio frequency fields. Avoid contact of any kind with primer, especially with metal objects. See TM 9-1300-200 for detailed ammunition handling instructions. Rechambering of live ammunition is prohibited.

▲ **Turn takeoff gear (E) clockwise using socket wrench handle until all ammunition has been removed from drum and exit unit.**

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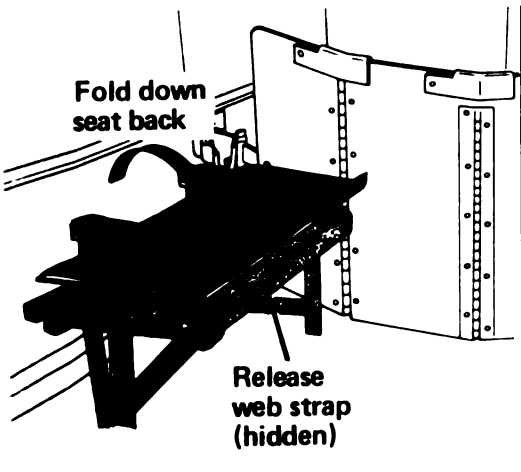
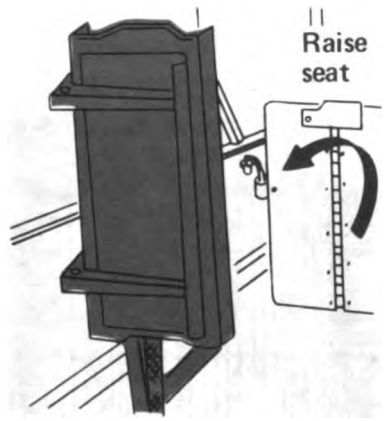
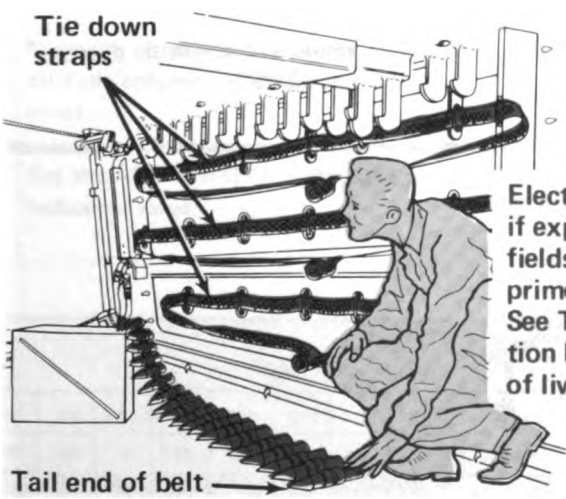
LOADING AMMUNITION STOWAGE RACK







WARNING

Electrically primed ammunition can fire if exposed to high-power radio frequency fields. Avoid contact of any kind with primer, especially with metal objects. See TM 9-1300-200 for detailed ammunition handling instructions. Rechambering of live ammunition is prohibited.

IMPORTANT - Make sure vehicle floor and ramp are clean, and use ground cover when ammunition is strung outside vehicle.

- Release ammunition tie-down straps.
- Remove ammunition from box and install green tail link (page 2-81).
- Lay out ammunition on vehicle floor, open side of links up, projectiles pointed toward right wall, and tail end of belt nearest ammunition drum.
- Check that each round is linked correctly (page 2-80).

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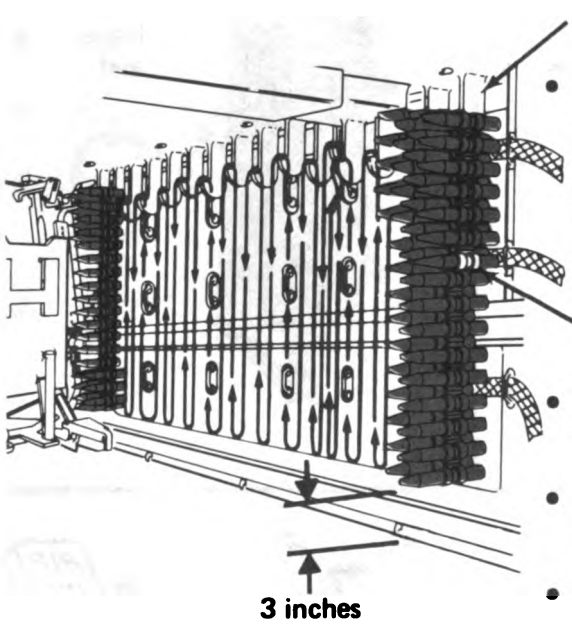
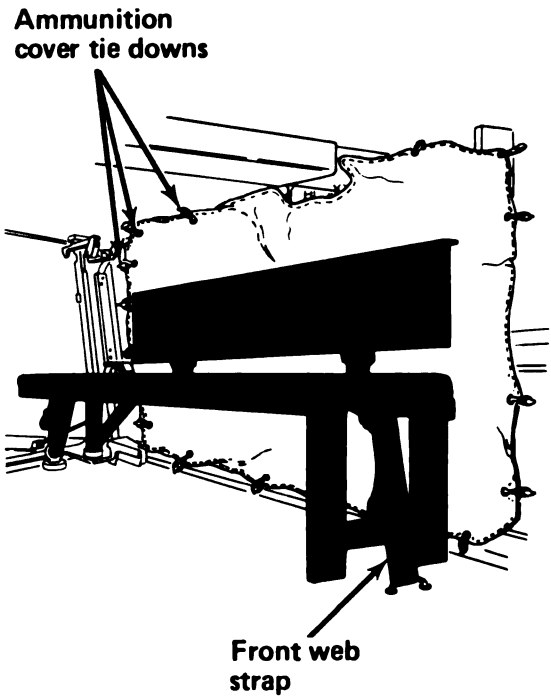
LOADING AMMUNITION STOWAGE RACK – CONTINUED



- Load rack from front to rear. Starting with tail end of ammunition belt, pick-up belt and hang over front support bracket. Hang belt so that lowest round in belt is about 3 inches off floor (23 to 27 rounds).
- Continue until required amount of ammunition is loaded in stowage rack.
- Install green leading link on end of last belt hung in rack (page 2-89).
- Secure ammunition with tie down straps (page 2-89).



- Install ammunition cover, notch to top. Secure with tie downs on cover.
- Lower seat, secure front web strap, and raise seat back.

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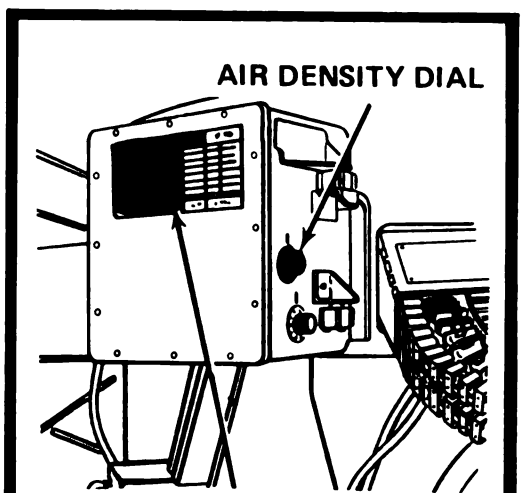
AIR DENSITY SETTING

2-8. Set the AIR DENSITY switch dial on the sight current generator according to local altitude and temperature. Do this as follows:

1. Determine the local altitude in feet. Determine the local temperature in degrees Fahrenheit (F).
2. Look at the AIR DENSITY DIAL SETTING CHART on sight current generator.
3. Refer to part of the chart that applies to air density. Select the column and line that most nearly represents the altitude and temperature.
4. Trace up the pertinent altitude column to the proper temperature line.
5. Note the numerical value where the altitude column and temperature line meet.
6. Set the AIR DENSITY switch dial to the indicated value.



AIR DENSITY DIAL SETTING chart

AIR DENSITY DIAL SETTINGS											TEMPERATURE IN DEGREES FAHRENHEIT	MUZZLE VELOCITY DIAL SETTINGS	
[illegible]	[illegible]	1.00	1.05	1.05	1.10	1.15	1.20	–	–	–	–70	8	9
[illegible]	[illegible]	[illegible]	1.00	1.00	1.05	1.10	1.15	1.20	1.20	–	–50	8	9
[illegible]	[illegible]	[illegible]	.95	.95	1.00	1.05	1.10	1.10	1.15	1.20	–30	7	8
[illegible]	[illegible]	[illegible]	.85	.90	.95	.95	1.00	1.05	1.10	1.10	0	7	8
[illegible]	[illegible]	[illegible]	.80	.95	.00	.00	.95	1.00	1.00	1.05	30	6	7
[illegible]	[illegible]	[illegible]	.75	.00	.80	.95	.90	.90	.95	1.00	70	5	6
[illegible]	[illegible]	[illegible]	.70	.75	.75	.80	.85	.95	.90	.95	90	5	6
[illegible]	[illegible]	[illegible]	.70	.70	.75	.75	.80	.80	.95	.90	130	4	5
[illegible]	[illegible]	[illegible]	7	6	5	4	3	2	1	0		0 – 36	36 – 72
ALTITUDE IN FEET X 1000												BARREL CLUSTER ROUNDS FIRED X 1000	

END

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MUZZLE VELOCITY SETTING

2-9. Set the MUZZLE VELOCITY switch dial on the sight current generator to compensate for temperature changes and barrel cluster wear. Do this as follows:

1. **Check the system log book and determine the number of total rounds fired on barrel cluster. Determine the local temperature (same as used for air density setting).**

2. **Look at the MUZZLE VELOCITY DIAL SETTING part of chart on sight current generator.**

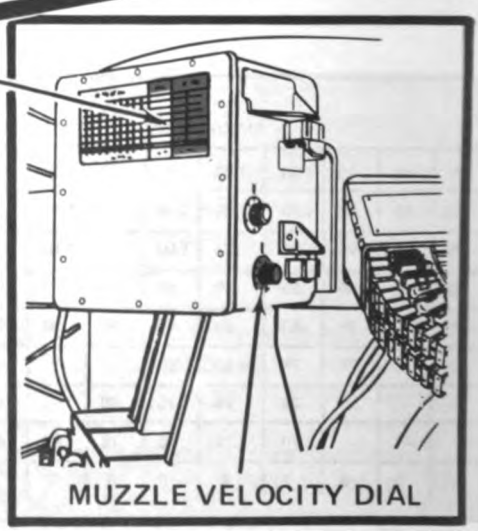
AIR DENSITY DIAL SETTINGS											TEMPERATURE IN DEGREES FAHRENHEIT	MUZZLE VELOCITY DIAL SETTINGS	
.95	.95	1.00	1.05	1.05	1.10	1.15	1.20	–	–	–	–70	8	9
.90	.90	.95	1.00	1.00	1.05	1.10	1.15	1.20	1.20	–	–50	8	9
.85	.85	.90	.95	.95	1.00	1.05	1.10	1.10	1.15	1.20	–30	7	8
.80	.80	.85	.85	.90	.95	.95	1.00	1.05	1.10	1.10	0	7	8
.75	.75	.80	.80	.85	.90	.90	.95	1.00	1.00	1.05	30	6	7
.70	.70	.75	.75	.80	.80	.85	.90	.90	.95	1.00	70	5	6
–	–	.70	.70	.75	.75	.80	.85	.85	.90	.95	90	5	6
–	–	–	.70	.70	.75	.75	.80	.80	.85	.90	130	4	5
10	9	8	7	6	5	4	3	2	1	0		0 – 36	36 – 72
ALTITUDE IN FEET X 1000												BARREL CLUSTER ROUNDS FIRED X 1000 *	

MUZZLE VELOCITY DIAL SETTING CHART

* REFER TO SYSTEM LOG BOOK

3. Select the rounds fired category that conforms with total barrel cluster rounds fired. Select the numerical value for the temperature that is closest to the local temperature.

4. Set MUZZLE VELOCITY DIAL to the numerical value.



MUZZLE VELOCITY DIAL

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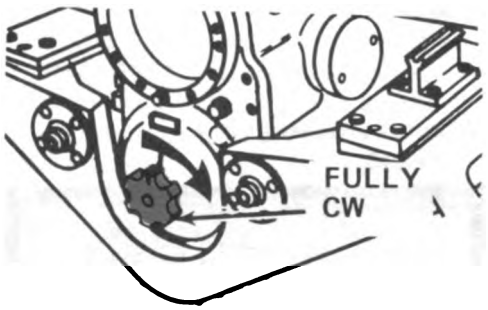
BALLISTIC CORRECTION CIRCUIT CARD

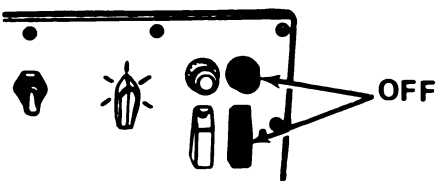
2-10. Check the dual-purpose BALLISTIC CORRECTION CIRCUIT CARD in the sight current generator (SCG) to make sure it is installed correctly for the ammunition (M246 or M220) that will be used.

NOTE: When cannon is used in GROUND MODE, the ballistic correction circuit board may be installed either way, and the following procedure may be ignored.

1. Make sure the sight is caged.



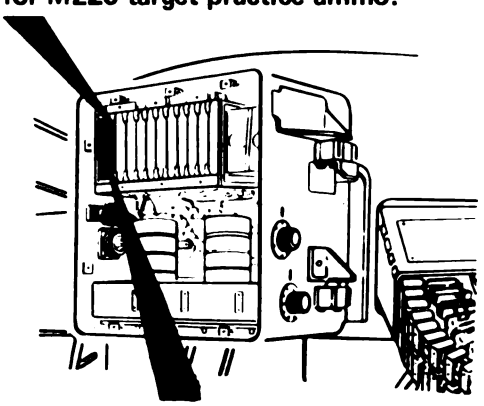
2. Set SYSTEM POWER switch to OFF.



BALLISTIC CORRECTION CIRCUIT CARD A12 – One end for M246 tactical ammo. Reverse card for M220 target practice ammo.

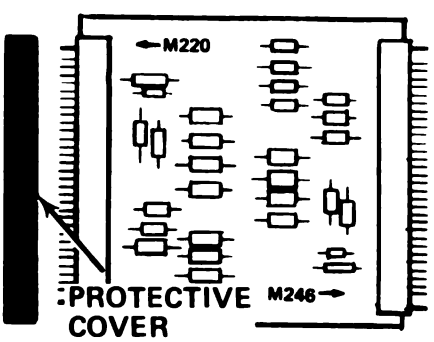
3. Remove cover from SCG.

CAUTION: Be careful when handling the ballistic correction circuit card. Do not damage wires, components, or connectors.



4. Remove the circuit card from the SCG. Notice that each end of the card is marked with an arrow and type of ammunition (M246 or M220).

5. Select the end corresponding to the ammunition that will be used. Install the protective cover on the opposite end.



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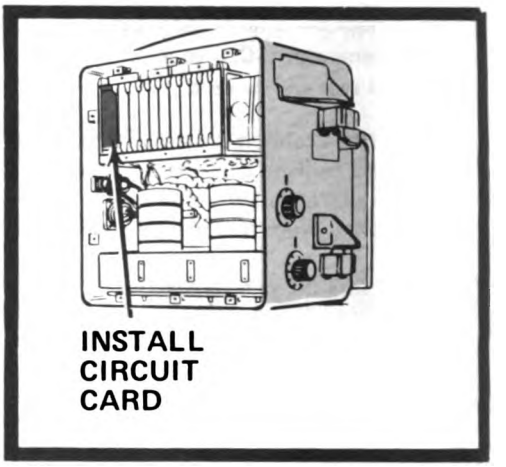
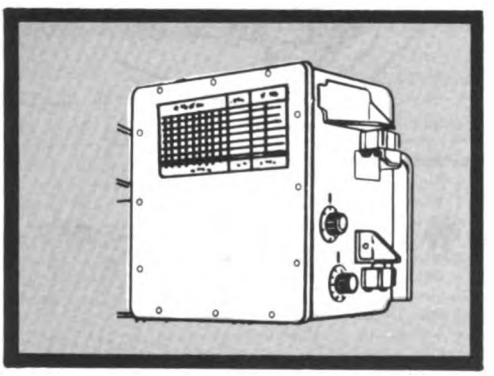
SIGHT CURRENT GENERATOR – CONTINUED

BALLISTIC CORRECTION CIRCUIT CARD (CONTINUED)

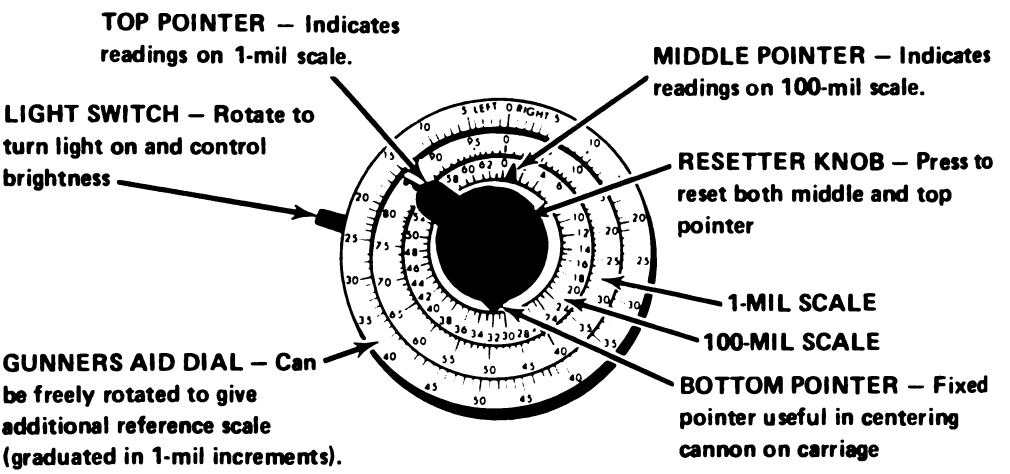
6. With the proper arrow pointing inward, carefully install and seat the circuit card in the SCG.



7. Install cover securely on SCG.



AZIMUTH INDICATOR



The azimuth indicator is normally used to lay indirect fire during the ground mode. Zero the top and middle pointers on the azimuth of the firing, or reference point. Make corrections by training the cannon as directed while observing the indicator.

The azimuth indicator can be used for any purpose that requires an accurate indication of cannon position in relation to a preset azimuth reference point.

END

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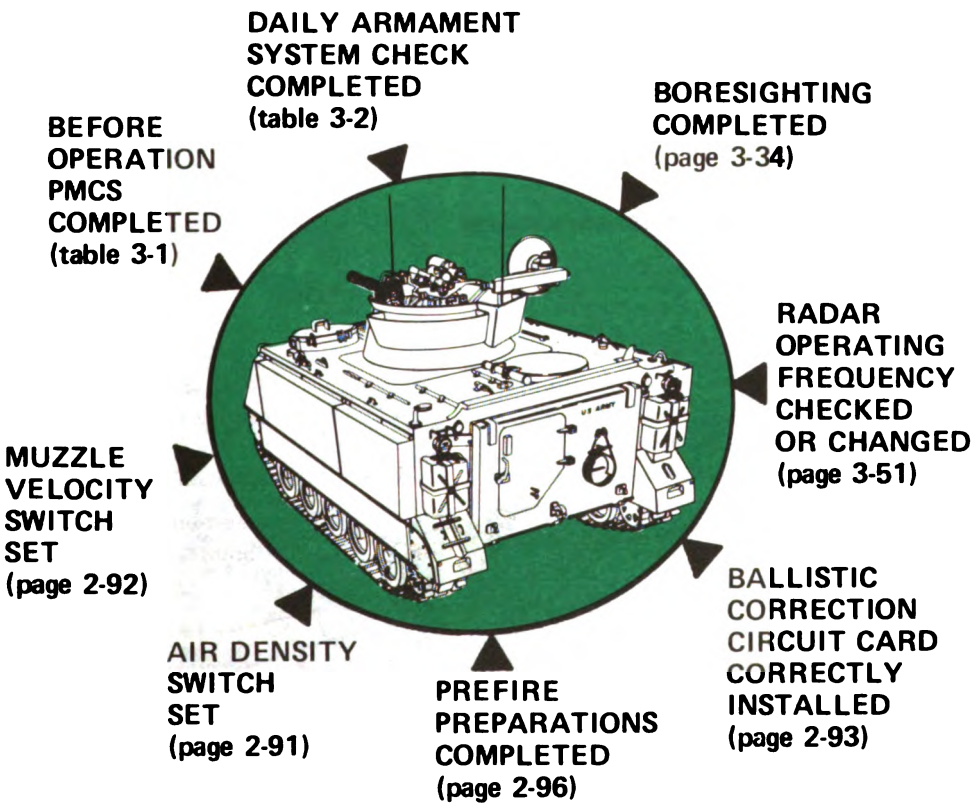
PREPARATION FOR FIRING

2-11. General. The steps that follow are the final preparations performed before firing. First verify that all BEFORE OPERATION PMCS, DAILY ARMAMENT SYSTEM CHECKS, BORESIGHTING, AND RADAR OPERATING FREQUENCY CHECKS have been completed. Final preparations consist of setting the fire control circuits for certain variable conditions such as; type of ammo to be used, muzzle velocity, and air density. This involves setting the AIR DENSITY and MUZZLE VELOCITY switches, and checking that the BALLISTIC CORRECTION circuit card is installed in correct position. Refer to the illustration below that shows a completely prepared, ready-to-fire system.



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2-12. Prefire Instructions. Follow these instructions to prepare your system for firing. If your daily PMCS, daily armament system check, and boresighting have been completed, your system should be in first class shape. In this case, all that remains are some mechanical procedures, visual checks, turn-on procedures, and simple last minute operational checks.

IMPORTANT. If you expect to fire on the move, or anticipate an attack while traveling, keep the system in a condition that allows immediate response. The system should be completely energized and the cannon free to traverse and elevate. Before starting such a move, the following prefire preparations should be performed.

1 VERIFY Before Operation PMCS Completed (Page 3-3)	**2** VERIFY Daily ARMAMENT SYSTEM Check Completed (Page 3-23)
3 VERIFY BORESIGHTING Completed (Page 3-34)	**4** VERIFY RADAR Frequency Checked or Changed (Page 3-51)

Make sure 1 through 4 have been completed before continuing.

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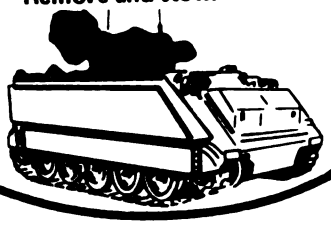
PREPARATION FOR FIRING – CONTINUED

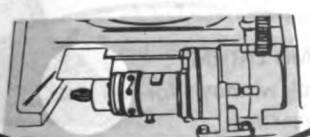
5 **PROTECTIVE COVERS**
Remove and stow.



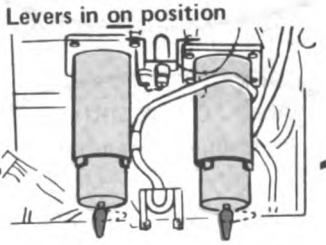
6 **BARREL CLUSTER**
Unclamp from travel lock. Lay travel lock on deck and secure with quick-release pin.

GUN DRIVE MOTOR BRAKE
levers in on position.

7 **ELEVATION DRIVE MOTOR BRAKE**
Lever in on position.

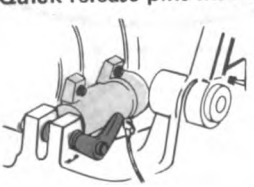


8 **AZIMUTH DRIVE MOTOR BRAKES (two)**
Levers in on position



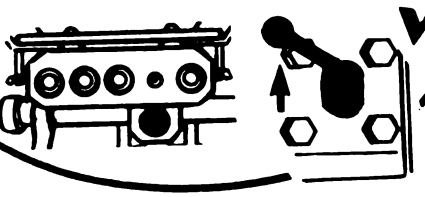
9 **GUN SHIELD**
Secure - with rear latches engaged and two quick-release pins installed.

10 **RECOIL ADAPTERS**
Quick release pins installed.



11 **VEHICLE ENGINE or APU**
Start to keep batteries charged.

12 **SUSPENSION LOCKOUT**
Extend (unless firing on the move)



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PREPARATION FOR FIRING – CONTINUED

12 **AIR DENSITY SETTING**
Set dial on sight current generator.
(page 2-91)

14 **MUZZLE VELOCITY SETTING**
Set dial on sight current generator.
(page 2-92)

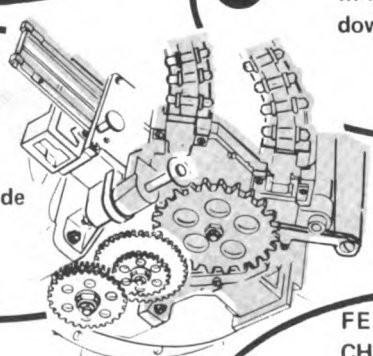
15 **BALLISTIC CORRECTION CIRCUIT CARD**
Check to see if installed properly.
(page 2-93)

16 **AMMO DRUM**
Check windows for full load. Reload if necessary.

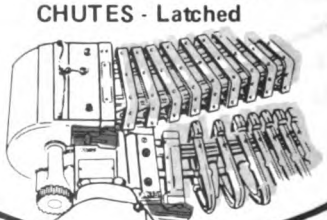
17 **AMMO DRUM DRIVE**
Shift pin in F position.

19 **CONVEYOR UNIT**
In firing position - handle down and locked.

18 **EXIT UNIT**
Link-stripping guide pulled up.



20 **FEED AND RETURN CHUTES - Latched**



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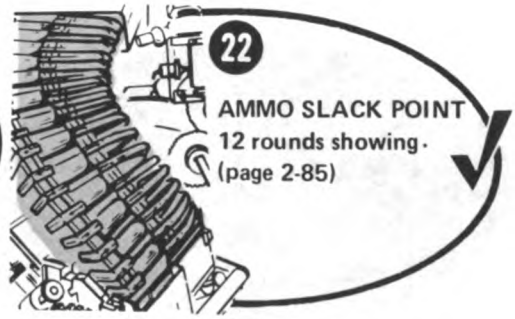
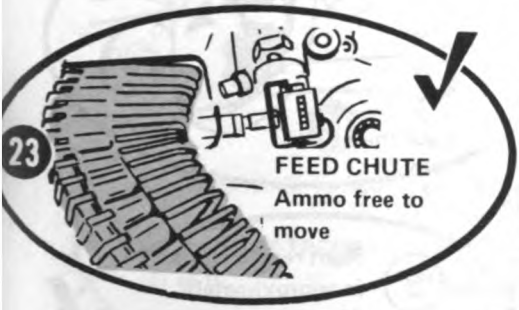
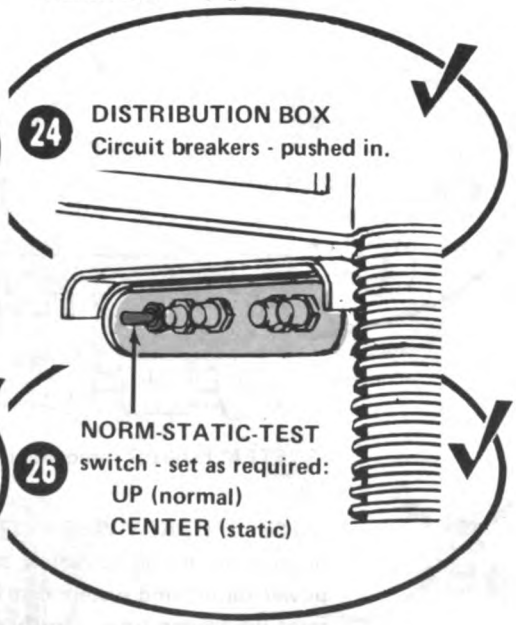
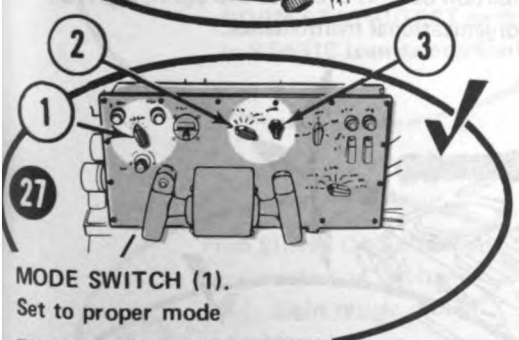
PREPARATION FOR FIRING – CONTINUED









PROCEDURE INDEX

Check/Procedure	Page
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Radar Turn-On	2-104
Antenna Unstowing	2-105
Energize Radar to Radiate	2-106
Antenna Servo Drive Check	2-107
Clutter Lockon Test	2-109
Midrange Calibration Check	2-111

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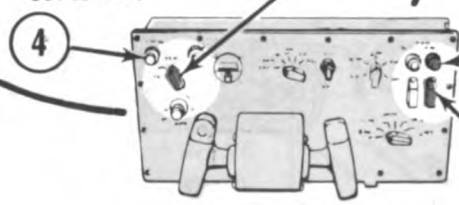
MANUAL MODE CHECK

28 FULLY CW

Cage the SIGHT.

29 MODE SWITCH (1) Set to MAN.

SYSTEM POWER (2) Set to ON.



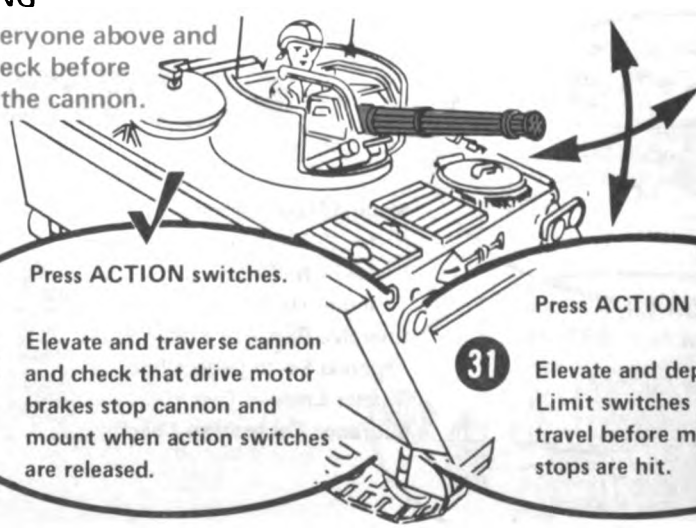
Sight reticle lights in approximately 10 seconds. Check that READY WHEN LIT indicator (4) lights after two minutes ± 15 seconds. See NOTE.

SYSTEM POWER indicator (3) lights.

NOTE: If READY WHEN LIT indicator (4) doesn't light after warmup, or goes out during operation, reset all tripped circuit breakers on radar power supply and system distribution box. If breakers trip again, DO NOT reset the second time. Notify organizational maintenance.

WARNING

Alert everyone above and below deck before moving the cannon.



30 Press ACTION switches.

Elevate and traverse cannon and check that drive motor brakes stop cannon and mount when action switches are released.

31 Press ACTION switches.

Elevate and depress cannon. Limit switches stop cannon travel before mechanical stops are hit.

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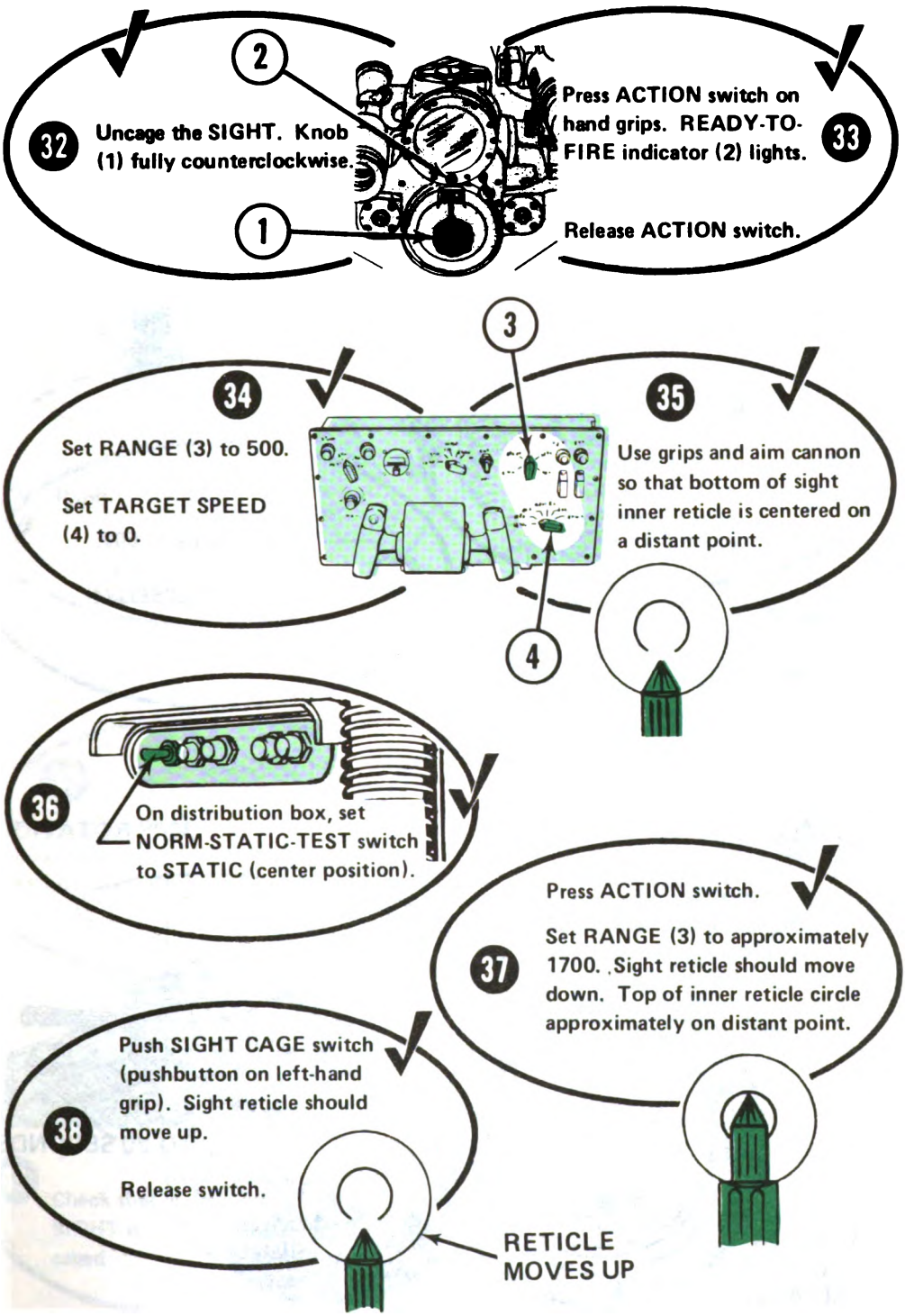
PREPARATION FOR FIRING – CONTINUED



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PREPARATION FOR FIRING – CONTINUED

33

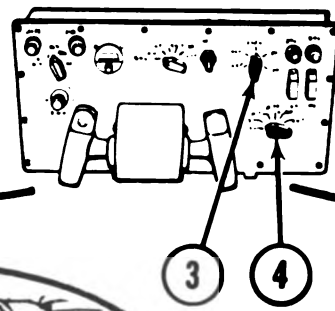
Set RANGE (3) to midway between 2000 and 2500.

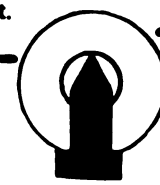
Set TARGET SPEED (4) to 600.

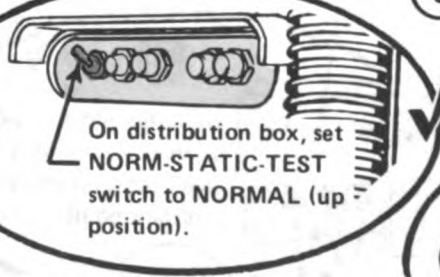
40

Press ACTION switch.

Sight reticle should move down. Top of inner reticle approximately on distant point.







41

On distribution box, set NORM-STATIC-TEST switch to NORMAL (up position).

42

Set RANGE (3) to 500.

Set TARGET SPEED (4) to 300.

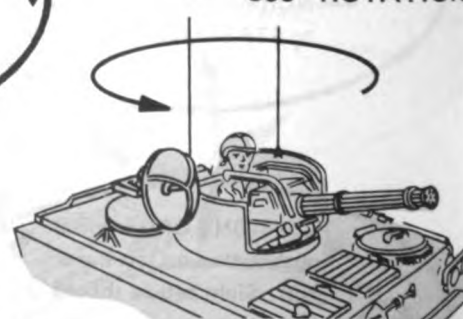
WARNING
Alert everyone above and below deck before moving the cannon.

43

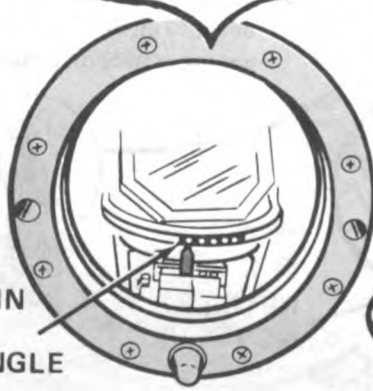
Press ACTION switch. Use grips to rotate mount while maintaining a 200 mil lead angle (extreme right or left dot in sight).

The time for one revolution should be 16 to 20 seconds.

360° ROTATION



16 TO 20 SECONDS



MAINTAIN 200 MIL LEAD ANGLE

CAGE THE SIGHT

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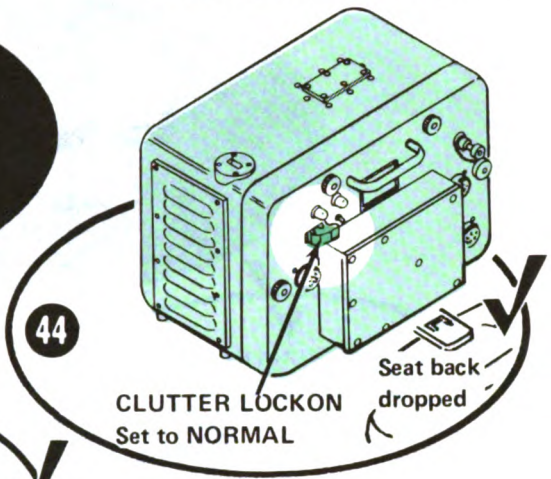
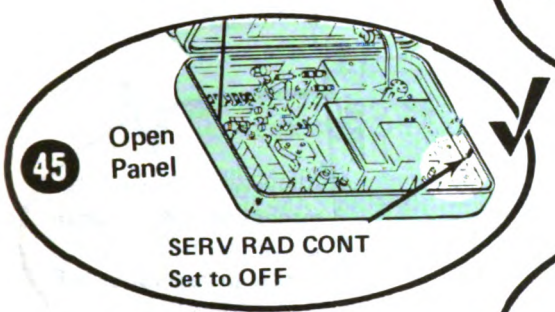
PREPARATION FOR FIRING – CONTINUED

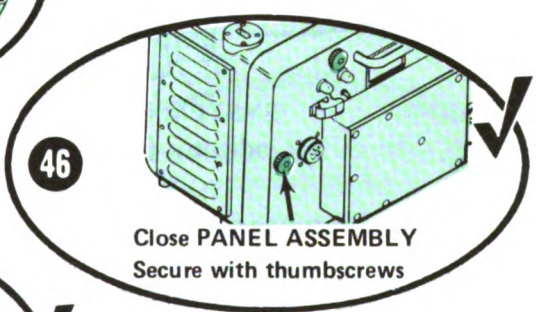
RADAR

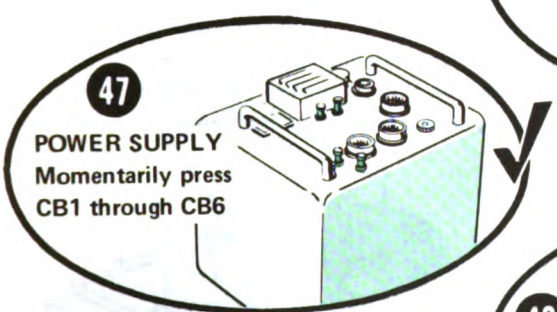
INITIAL CONTROL SETTINGS

RECEIVER-TRANSMITTER

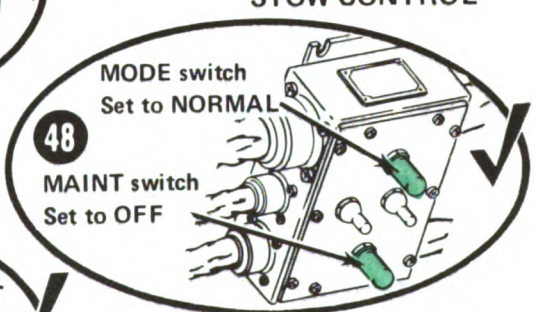


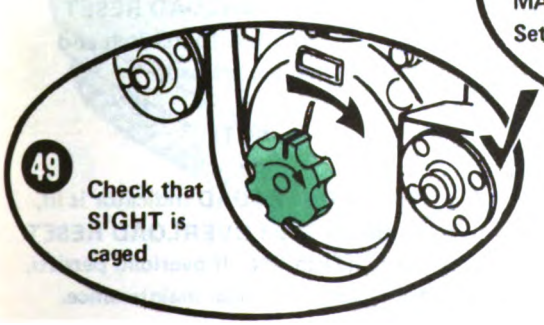






STOW CONTROL





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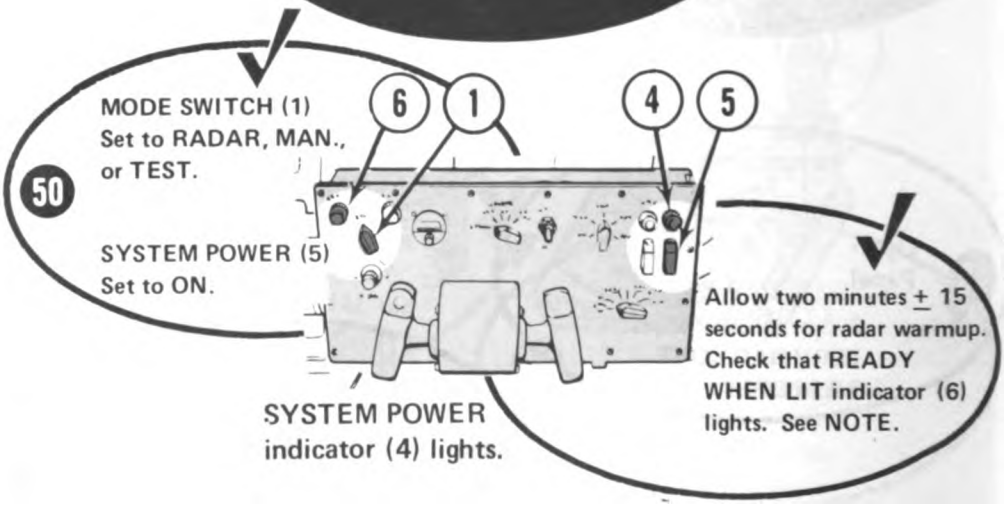
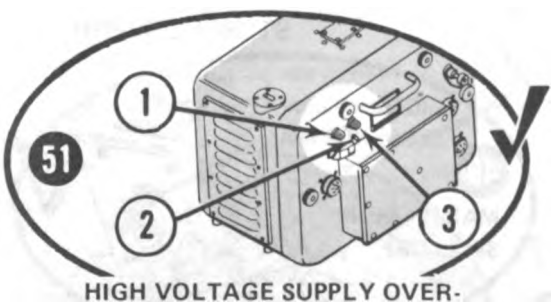
RADAR TURN-ON



NOTE: If READY WHEN LIT indicator (6) doesn't light after warmup, or goes out during operation, reset all tripped circuit breakers on the radar power supply and system distribution box. If breakers trip again, DO NOT reset the second time. Notify organizational maintenance.



HIGH VOLTAGE SUPPLY OVER-LOAD indicator (1)
Not lit.

MODULATOR OVERLOAD indicator (3)
Not lit.

CAUTION

DO NOT set OVERLOAD RESET switch to ON while footswitch and action switch are pressed.

NOTE

If either OVERLOAD indicator is lit, momentarily set OVERLOAD RESET switch (2) to ON. If overload persists, notify organizational maintenance.

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ANTENNA UNSTOWING

CAUTION

Never rotate antenna by hand. If you force the antenna gearing without electrically releasing the brake, the brake may be damaged.

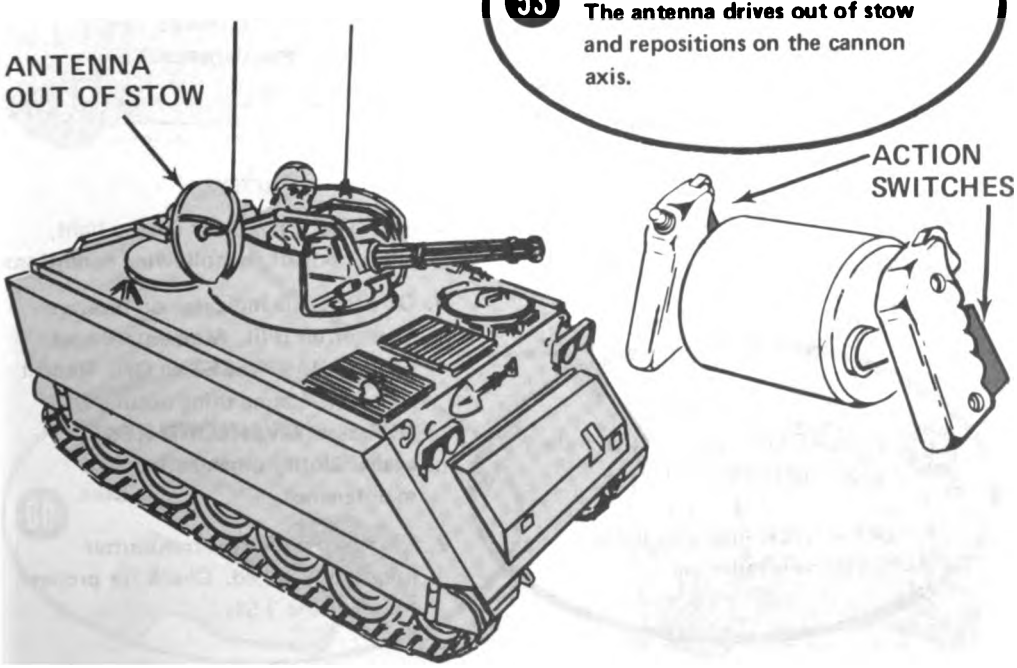
52 **RECHECK SWITCHES**

Control Assembly
- **MODE-MAN or RADAR**
- **SYSTEM POWER-ON**

Stow Control
- **MODE-NORMAL**
- **MAINT-OFF**

53 **Depress ACTION SWITCH on right or left hand grip.**

The antenna drives out of stow and repositions on the cannon axis.



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ENERGIZE RADAR TO RADIATE

WARNING
Radar emissions are hazardous within three feet of the antenna.

CAUTION
Do not radiate at targets closer than 250 meters. This will damage the radar receiver (unit 3).

54 **RECHECK SWITCHES**

Control Assembly

- **MODE–RADAR or TEST**
- **SYSTEM POWER-ON**
  READY WHEN LIT - light ON

NOTE

When radiating, the following temporary condition may occur: The READY WHEN LIT light, the sight ready-to-fire light, and the waveguide RF indicator go out. Immediately release the footswitch, cage the sight (if uncaged), and set the MODE switch to GRD. Wait five seconds and reset MODE switch to RADAR, uncage the sight (if required), and continue the check. If condition persists, notify organizational maintenance.

CAUTION
Do not set OVERLOAD RESET to ON while footswitch and action switch are pressed.

55 **Press ACTION switch first – then press FOOTSWITCH.**

RF POWER indicator lights. Antenna is radiating.

NOTE

If RF POWER indicator fails to light, check for one of the following conditions.

1. **OVERLOAD indicator on receiver-transmitter is lit. Momentarily set OVERLOAD RESET to ON. Repeat step 55. If same thing occurs, DO NOT reset OVERLOAD RESET again. Notify organizational maintenance.**
2. **Klystron in receiver-transmitter improperly tuned. Check for proper tuning (page 3-51).**

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PREPARATION FOR FIRING – CONTINUED

ANTENNA SERVO DRIVE CHECK

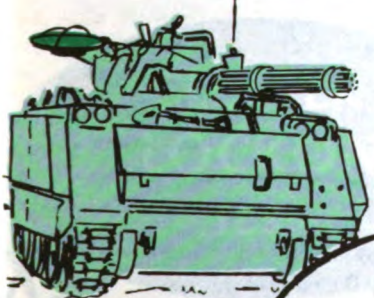
56 FULLY CW

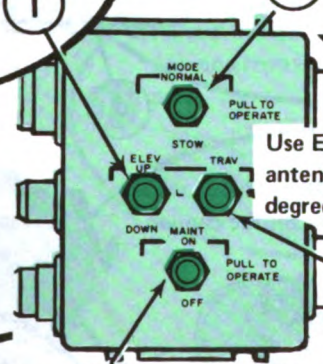
Cage the SIGHT.

57 SYSTEM POWER-ON

Cannon positioned at approximately 0 degree elevation.

MAINT switch (4)–ON
MODE switch (2)–STOW

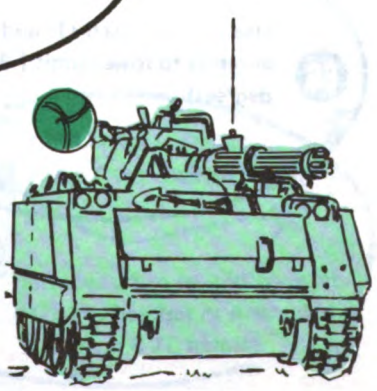




58 Use ELEV switch (1) and drive antenna to upper limit (95-97 degrees).

59 MAINT switch (4)–OFF
MODE switch (2)–NORMAL

60 Press ACTION switch. Check that antenna repositions on the cannon axis.



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PREPARATION FOR FIRING – CONTINUED

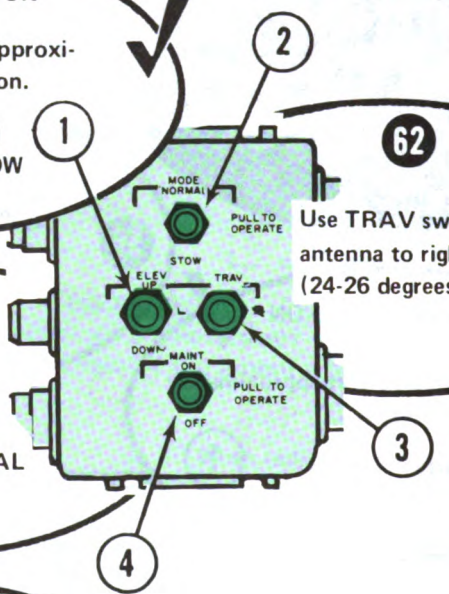
SYSTEM POWER-ON

61 Cannon positioned at approximately 0 degree elevation.

MAINT switch (4)–ON
MODE switch (2)–STOW

62 Use TRAV switch (3) and drive antenna to right-hand limit (24-26 degrees).

63 MAINT switch (4)–OFF
MODE switch (2)–NORMAL



64 Press ACTION switch. Check that antenna repositions on the cannon axis.

65 Cannon positioned at approximately 0 degree elevation.

MAINT switch (4)–ON
MODE switch (2)–STOW

66 Use ELEV switch (1) and drive antenna to lower limit (-8 to -12 degrees)

67 MAINT switch (4)–OFF
MODE switch (2)–NORMAL

Press ACTION switch. Check that antenna repositions on the cannon axis.

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PREPARATION FOR FIRING – CONTINUED

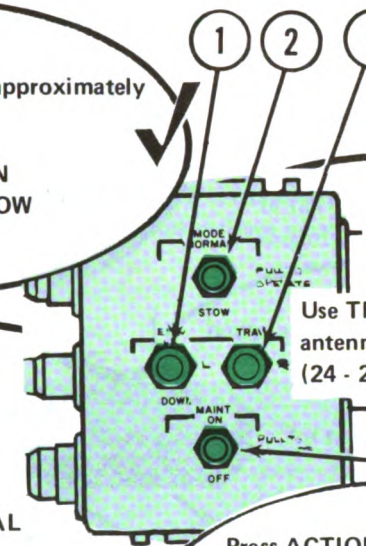
68 Cannon positioned at approximately 0 degrees elevation.

MAINT switch (4)–ON
MODE switch (2)–STOW

69 Use TRAV switch (3) and drive antenna to left-hand limit (24 - 26 degrees).

70 MAINT switch (4)–OFF
MODE switch (2)–NORMAL

71 Press ACTION switch. Check that antenna repositions on the cannon axis.



CLUTTER LOCKON TEST

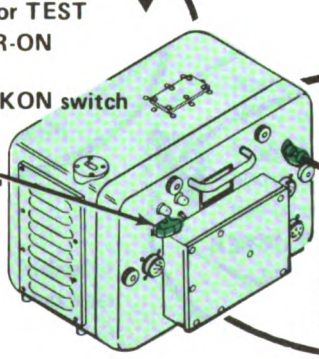
72 RECHECK SWITCHES

Control Assembly
- MODE-RADAR or TEST
- SYSTEM POWER-ON

Set CLUTTER-LOCKON switch to ON.

UNBANDED LEAD–
From CVC helmet

Remove J4 cover and connect H251/U headset or unbanded lead from CVC helmet.



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PREPARATION FOR FIRING – CONTINUED

WARNING

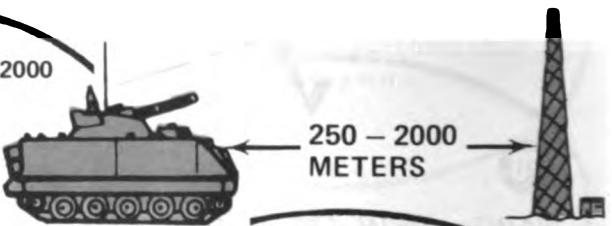
Radar emissions are hazardous within three feet of the antenna.

CAUTION

Do not radiate at targets closer than 250 meters. This will damage the radar receiver (unit 3).

73

- Find a fixed target 250 to 2000 meters away.
- Aim cannon at point in sky above the target.



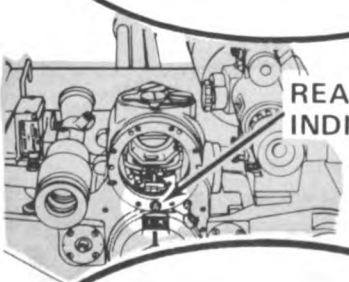
74

- Depress ACTION switch and FOOTSWITCH to radiate.
- No tone will be heard in CVC headset – this indicates no clutter lockon.

75

Slowly depress cannon until target appears in sight reticle.

A tone will be heard and the sight ready-to-fire indicator lights.



76

Slowly elevate cannon towards original position.

Tone stops and ready-to-fire indicator goes out when target disappears from sight reticle.

77

Release FOOTSWITCH and ACTION switch

Set receiver-transmitter CLUTTER LOCKON switch to NORMAL.

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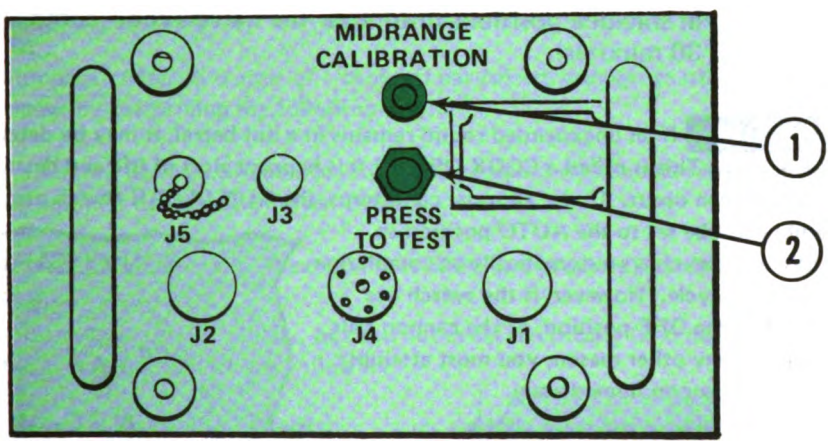
MIDRANGE CALIBRATION CHECK

NOTE

The MIDRANGE CALIBRATION indicator (1) in the off state is dimly lit and flashing about once per second. In the on state, the indicator stays brightly lit.



RANGE COMPUTER

78 Push in PRESS TO TEST switch (2) and hold.

MIDRANGE CALIBRATION indicator (1) lights brightly within five seconds. See NOTE.

79 Release PRESS TO TEST switch (2) – note that MIDRANGE CALIBRATION indicator stays lit for about three seconds after switch has been released (three-second fade). See NOTE.

NOTE

If MIDRANGE CALIBRATION indicator (1) does not light or, after switch has been released, stays bright only momentarily – notify organizational maintenance.

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PRECAUTIONS WHEN FIRING

2-13. When firing, always be prepared for any malfunction that could cause a potential hazard to personnel or equipment.

WARNING

If cannon cannot be cleared, keep it positioned in a direction so that possible damage or loss of life will not result if ammunition COOK-OFF occurs. If there is danger of a COOK-OFF, personnel should remain out of range or in shielded positions until after the barrels cool (about 30 minutes).

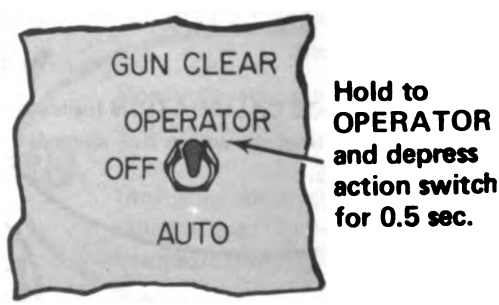
COOK-OFF If an unexpended round remains in a hot barrel, it may be detonated by the residual heat. This is called a COOK-OFF. If this happens, loss of life and destruction of the cannon can occur. Under all usual conditions, the GUN CLEAR switch on the control assembly will be set to the AUTO position so that the cannon clears automatically at completion of the firing cycle. However, if the switch has been left in the OFF position, or the cannon fails to clear for any other reason, you must attempt to clear the cannon immediately.

Operator Clearing

1. Aim the cannon towards a safe area

2. Hold GUN CLEAR switch in OPERATOR position and depress ACTION switch for approximately 0.5 second. If this doesn't clear the cannon, do next step.

3. Quickly depress SYS PWR circuit breaker on the distribution box and try to clear the cannon. If cannon still will not clear, set SYSTEM POWER to OFF, take cover, and notify organizational maintenance.



NOTE: Using right hand to activate GUN CLEAR switch and left hand to depress left-hand ACTION switch will elminate accidental activation of the firing trigger.

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PRECAUTIONS WHEN FIRING – CONTINUED

WARNING

HANG-FIRE During firing, a round may not fire until after the clearing cycle starts. This is a HANG-FIRE and can result in death or injury to personnel and damage to the cannon. If ammunition doesn't fire normally, immediately stop firing and take cover. Dispose of defective ammo according to TM 9-1300-206 and/or local regulations.

STOPPAGES A stoppage is the result of an unexpected occurrence that interrupts the firing cycle and/or prevents the firing of the cannon on command from the gunner. Always clear the cannon immediately after a stoppage that occurs during a firing cycle (see "Operator clearing"). This must be done to prevent a COOK-OFF. If cannon will not clear, take cover for 30 minutes until the barrels cool before trying to find the cause of the stoppege.

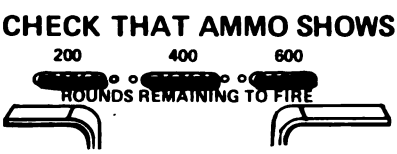
Correcting a Stoppage. After all danger of a cook-off has passed, attempt to isolate the cause of a stoppage by performing the following steps:

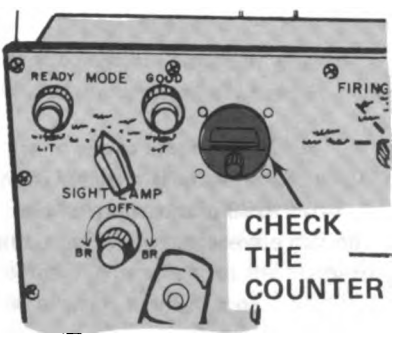
1. Set control assembly GUN CLEAR switch to AUTO. Inspect cannon and feed system. Make certain ammo is not binding in feed chute.

2. Attempt to fire a 10-round burst. If cannon fires and clears properly, continue operation.

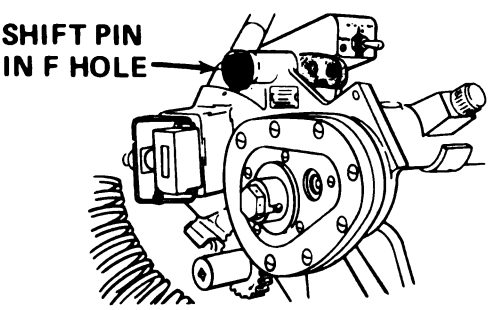
3. If the cannon can be cleared manually, but will not cycle electrically (and no sign of obstruction can be found) check the following:

   a. Make sure ammo is available. Check rounds expended counter and storage drum.





   b. The shift pin is in the F (fire) hole.



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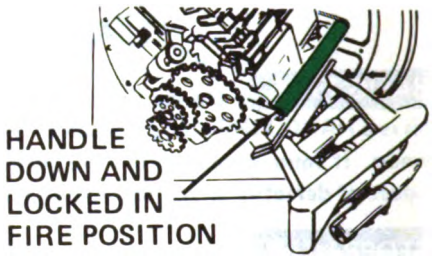
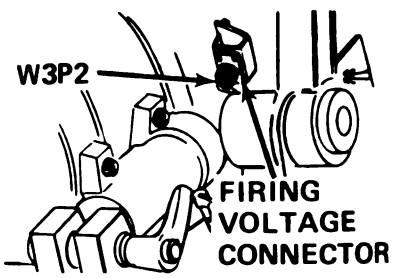
PRECAUTIONS WHEN FIRING—CONTINUED

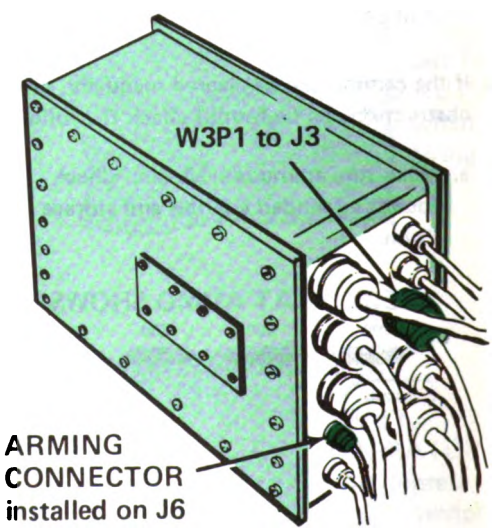
c. The conveyor unit is down and locked.



d. The firing connector is securely mounted with W3P2 securely connected.



e. The arm safe cable, or arming connector is securely connected to J6 on distribution box. W3P1 connector connected to J3.



4. If cannon still will not fire, notify organizational maintenance.

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FIRING

2-14. General. The system can be operated in four different modes. Selection of the proper mode and firing rate depends on the target and tactical circumstances. Both aerial and ground targets can be engaged. The following paragraphs describe each mode briefly, and provide step-by-step instructions for firing in the various modes.

2-15. Radar Mode. The greatest accuracy against aerial targets is obtained in the radar mode. Using radar, the fire control system automatically computes target speed and range data and furnishes lead angle information to the M61 sight.

2-16. Manual Mode. Normally used against aerial targets, but can be used against ground targets. A lead angle for moving targets, and superelevation for fixed or moving targets are provided by the fire control system. The gunner presets the TARGET RANGE and TARGET SPEED knobs on the control assembly to the anticipated target speed and to the range at which he expects to fire. The experienced gunner will also select, for reference, a terrain feature he knows to be at the same range at which he expects to fire. He will then concentrate on firing when he sees the target at the same distance as his reference point.

2-17. Ground Mode (NORM). Used against ground targets. The lead computing feature of the M61 sight is inoperative, and the sight is kept mechanically caged. However, it can still be used by aligning the target (depending on distance) with different areas on the sight reticle image. This is described on page 2-124. The M134 straight telescope or the AN/TVS-2B night sight can also be used to control fire. The choice depends on visibility and accuracy desired. Fire is adjusted by observing the splash of rounds and adjusting aim accordingly. In this ground mode, the servo-drive system remains energized so that the cannon can be elevated and traversed as required.

2-18. Ground Mode (STATIC). The cannon is fixed and used against a specific ground target or area. The servo-systems are deenergized and the cannon cannot be moved in elevation or azimuth while in this mode.

2-19. External Mode. Can be used against aerial or ground targets. This mode requires two operators, a gunner to operate the cannon and a range setter to operate an external range control unit. The range setter estimates target range, correspondingly sets a dial on the external range control, and depresses a pushbutton switch. This energizes the ready-to-fire light on the M61 sight and advises the gunner that the target is within range.

2-20. Firing with Remote Arm-Safe Switch. The remote arm-safe switch assembly is connected, in place of the arming connector, to J6 on the system power distribution box. With the arm-safe switch connected, the cannon will not fire until the switch pushbutton is depressed and held.

2-21. Firing Rates. Two firing rates are available. The gunner selects either the HI rate (3000 shots per minute) or the LO rate (1000 shots per minute) by setting the FIRING RATE switch on the control assembly. In the HI rate, he must also select an automatic BURST LIMIT of 10, 30, 60, or 100 rounds.

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FIRING – CONTINUED

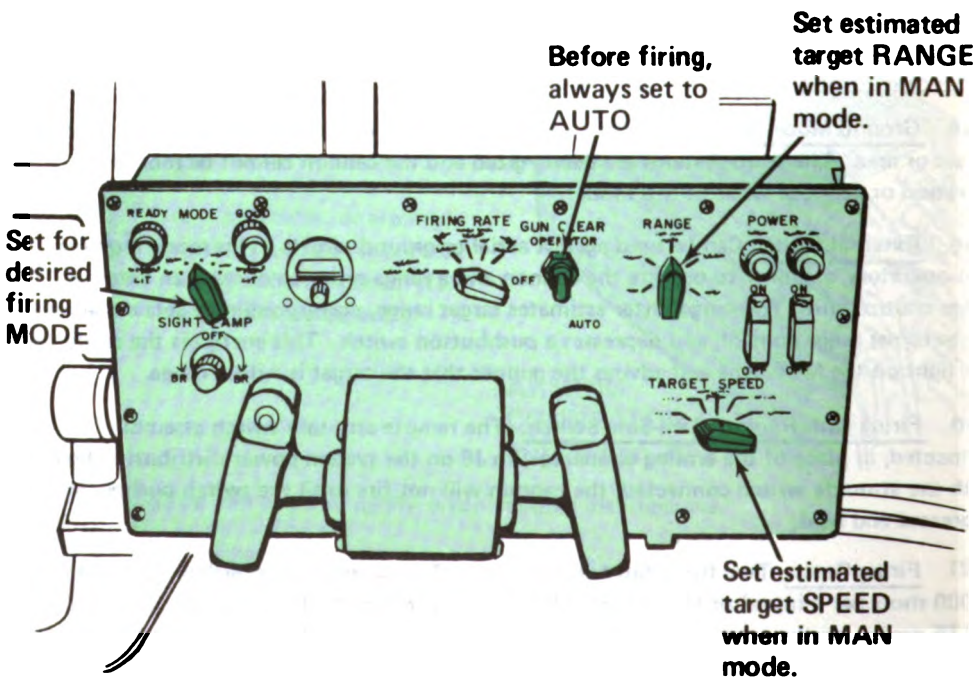
2-22. Automatic Clearing. The GUN CLEAR switch on the control assembly should always be set to the AUTO position before firing. The cannon then clears itself automatically after every firing cycle. Refer to "Precautions When Firing", page 2-112, for additional information on clearing the cannon.

WARNING

If cannon is not cleared immediately after firing, danger of a cook-off exists. Keep cannon aimed at the target area until cannon has been cleared. Refer to COOK-OFF, page 2-112.

WARNING

During a firing cycle, if the ammunition does not fire normally (hang-fire condition), firing operations shall be terminated immediately. Personnel will take cover until cannon has been cleared and defective ammunition disposed of. Refer to HANG-FIRE, page 2-113



CONTROL ASSEMBLY

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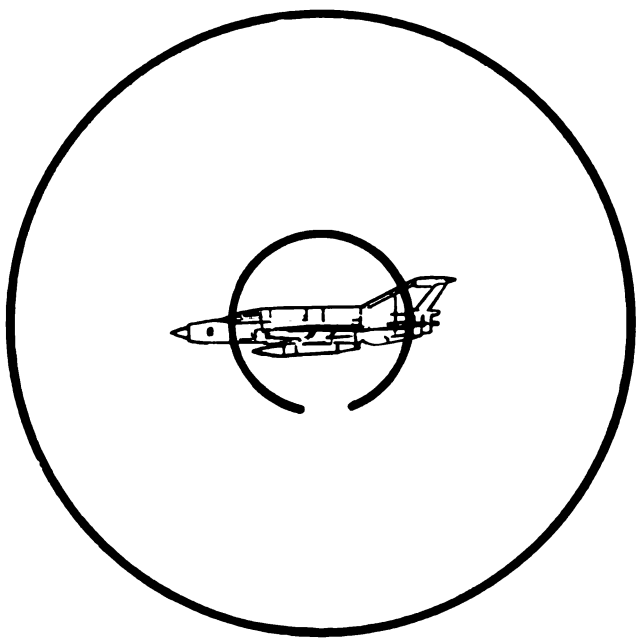
MARKSMANSHIP

2-23. Your M61 lead computing sight and the AN/VPS-2 radar automatically compute the correct lead angle required to hit an aerial target. However, you must also do your part. The key to good marksmanship is smooth tracking after the target is centered in the inner sight reticle, and waiting for a recommended interval before pressing the trigger button.

2-24. There is a tendency to fire as soon as the sight picture is perfect. This will work in rifle or pistol shooting – IT WILL NOT WORK with your Vulcan system. After the ready-to-fire light comes on, you must smoothly track for a short interval until the sight settles to the correct lead angle. Then with the target stationary inside the inner reticle, press the trigger button and fire. Be careful not to disrupt your smooth tracking as you press the trigger button. Continue to track smoothly, during and after firing, keeping the target inside the inner reticle. If you do not wait that short interval or, if tracking is not smooth, you will miss. The length of the applicable interval you must wait is given in the specific firing instructions for RADAR and MANUAL modes of firing. Get into the habit of counting off these intervals (1001, 1002, etc.) before firing.



SMOOTH TRACKING DOES IT.

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FIRING – CONTINUED

RADAR MODE

1 Do your PREPARATION FOR FIRING (page 2-96)

2 Set distribution box NORM-STATIC-TEST switch to NORM.

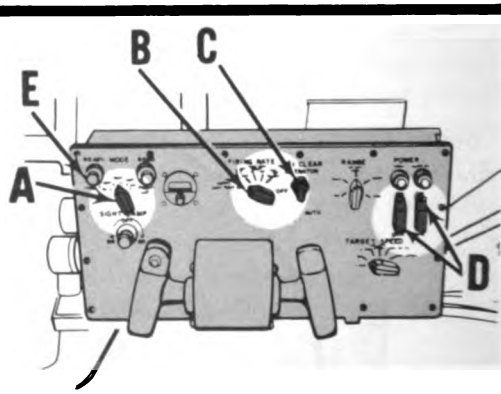
3 Check that sight is caged by rotating the CAGED knob clockwise to its stop.

4 Set MODE select switch (A) to RADAR.

Set FIRING RATE switch (B) to desired HI-BURST LIMIT (high rate).

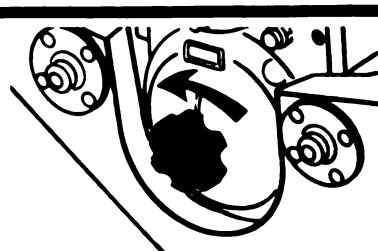
Set GUN CLEAR switch (C) to AUTO.

Set SYSTEM and GUN POWER switches (D) to ON.



IMPORTANT - Let radar warm up 2 minutes ± 15 seconds before using. READY WHEN LIT indicator (E) lights when radar is ready.

5 Turn sight CAGED knob fully counterclockwise to uncage sight.



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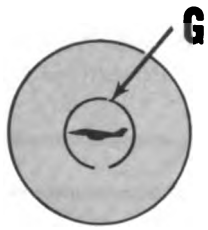
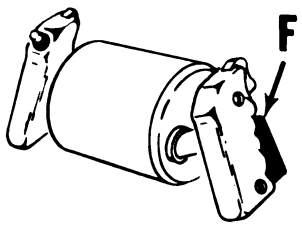
FIRING – CONTINUED

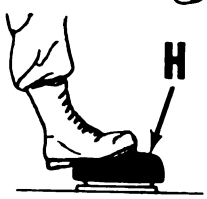
RADAR MODE – Continued

6

Press grip assembly action switch (F) and using grip assemblies, position mount so that target is in center of inner reticle (G). While continuing to track target, press and hold footswitch (H). When radar locks on target, the mount will momentarily speed up and then return to previous tracking rate. When ready-to-fire indicator on sight comes on, track target smoothly for at least one second before pressing trigger to begin firing.







IMPORTANT – If ready-to-fire indicator blinks rapidly, the radar is being jammed. Release footswitch and set control assembly MODE switch to MAN and proceed to fire in manual mode (page 2-120).

WARNING

Observe warnings and know procedures on cookoffs, hangfires, and stoppages (page 2-112).

7

Keep trigger depressed until cannon stops firing. If more than one burst is desired, depress trigger again. Release action and footswitch after firing is completed.

END

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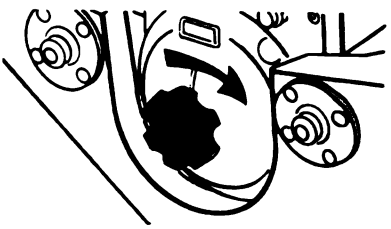
FIRING – CONTINUED

MANUAL MODE

1 Do your PREPARATION FOR FIRING (page 2-96)

2 Set distribution box NORM-STATIC-TEST switch to NORM.

3 Check that sight is caged by rotating the CAGED knob clockwise to its stop.

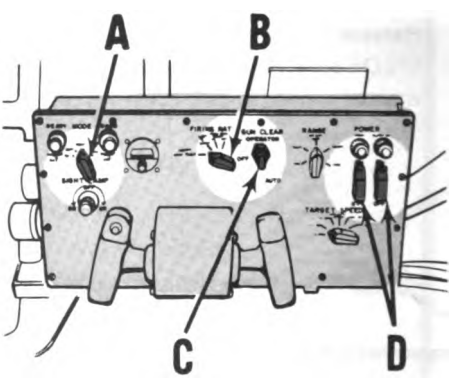


4 Set MODE select switch (A) to MAN.

Set FIRING RATE switch (B) to HI-BURST LIMIT (high rate) or LO-NO BURST LIMIT (low rate).

Set GUN CLEAR switch (C) to AUTO.

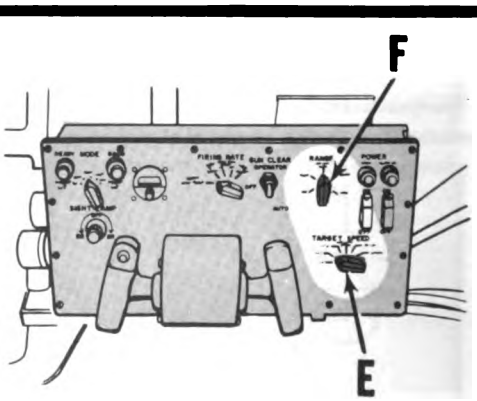
Set SYSTEM and GUN POWER switches (D) to ON.



5 When target is observed:

Set TARGET SPEED switch (E) to estimated target speed.

Set RANGE switch (F) to estimated range of target.



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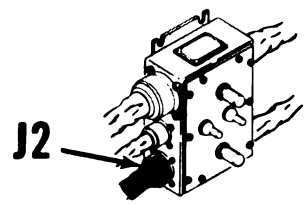
FIRING – CONTINUED

MANUAL MODE – Continued

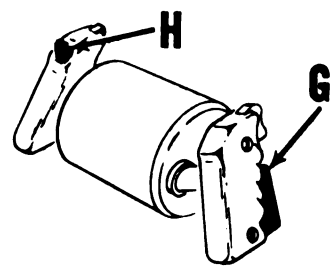
6 Turn sight CAGED knob fully counterclockwise to uncage sight.

NOTE: In manual mode, the ready to fire indicator on the sight remains lit as long as action switch is depressed.

IMPORTANT – If the radar antenna does not follow the cannon, disconnect cable connector W7P2 from stow control J2.

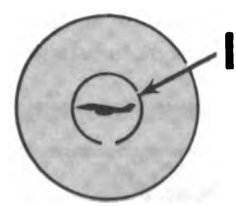


7 Press either grip assembly action switch (G) and hold sight cage button (H) with left thumb. Position mount so that target is in center of inner reticle. With target in center of inner reticle (I), release sight cage button (H) and start tracking smoothly.



If target range is 800 meters, track for 1 second, 1500 meters 2 seconds, and 1800 meters 3 seconds.

When target is centered in reticle begin firing at the end of these times.



WARNING

Observe warnings and know procedures on cookoffs, hangfires, and stoppages (page 2-112)

8 If firing in low rate, release trigger to stop firing. Do not attempt to fire a burst of less than 10 rounds. If firing in high rate, keep trigger depressed until cannon stops firing. If more than one burst is dasired, set in new range of target, continue smooth tracking for required time and depress trigger again.

END

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FIRING – CONTINUED

GROUND MODE (NORM)

1 Do your PREPARATION FOR FIRING (page 2-96)

2 Set distribution box NORM-STATIC-TEST switch to NORM.

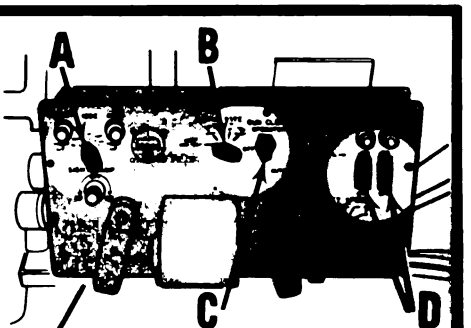
3 Check that sight is caged by rotating the CAGED knob clockwise to its stop.

4 Set MODE select switch (A) to GRD.

Set FIRING RATE switch (B) to HI-BURST LIMIT (high rate) or LO-NO BURST LIMIT (low rate).

Set GUN CLEAR switch (C) to AUTO.

Set SYSTEM and GUN POWER switches (D) to ON.



5 Press grip assembly action switch and using grip assemblies, position cannon to bear on target in azimuth and elevation. (See page 2-124 for approximate sight picture/target size relationships). Begin firing.

6

WARNING

Observe warnings and know procedures on cookoffs, hangfires, and stoppages (page 2-112).

7 If firing in low rate, release trigger to stop firing. Do not attempt to fire a burst of less than 10 rounds. If firing in high rate, keep trigger depressed until cannon stops firing. If more than one burst is desired, depress trigger again.

END

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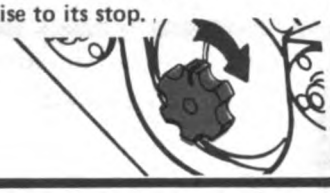
FIRING – CONTINUED

GROUND MODE (STATIC)

NOTE: In the ground (STATIC) mode, the servo drives are deenergized. The cannon cannot be moved in azimuth or elevation during firing.

1 Do your PREPARATION FOR FIRING (page 2-96).

2 Check that sight is caged by rotating the CAGED knob clockwise to its stop.

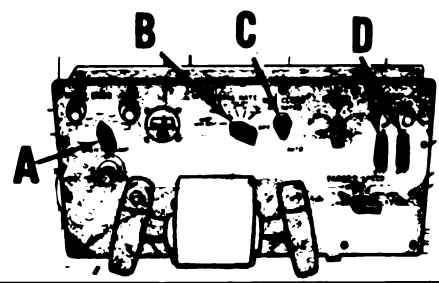


3 Set MODE select switch (A) to GRD.

Set FIRING RATE switch (B) to HI-BURST LIMIT (high rate) or LO-NO BURST LIMIT (low rate).

Set GUN CLEAR switch (C) to AUTO.

Set SYSTEM and GUN POWER switches (D) to ON.



4 Set distribution box NORM-STATIC-TEST switch to NORM. Press action switch and position cannon to bear on target in azimuth and elevation. See page 2-124 for approximate sight picture/target size relationships.

5 Set distribution box NORM-STATIC-TEST switch to STATIC (center position).

If situation permits, fire short burst to check accuracy. If burst is on target, proceed to step 6. If not on target, set distribution box NORM-STATIC-TEST switch to NORM (up position) and repeat steps 4 and 5 to correct zero. zero.

WARNING

Observe warnings and know procedures on cookoffs, hang-fires, and stoppages (page 2-112).

6 If firing in low rate, release trigger to stop firing. Do not attempt to fire a burst of less than 10 rounds. If firing in high rate, keep trigger depressed until cannon stops firing. If more than one burst is desired, depress trigger again.

END

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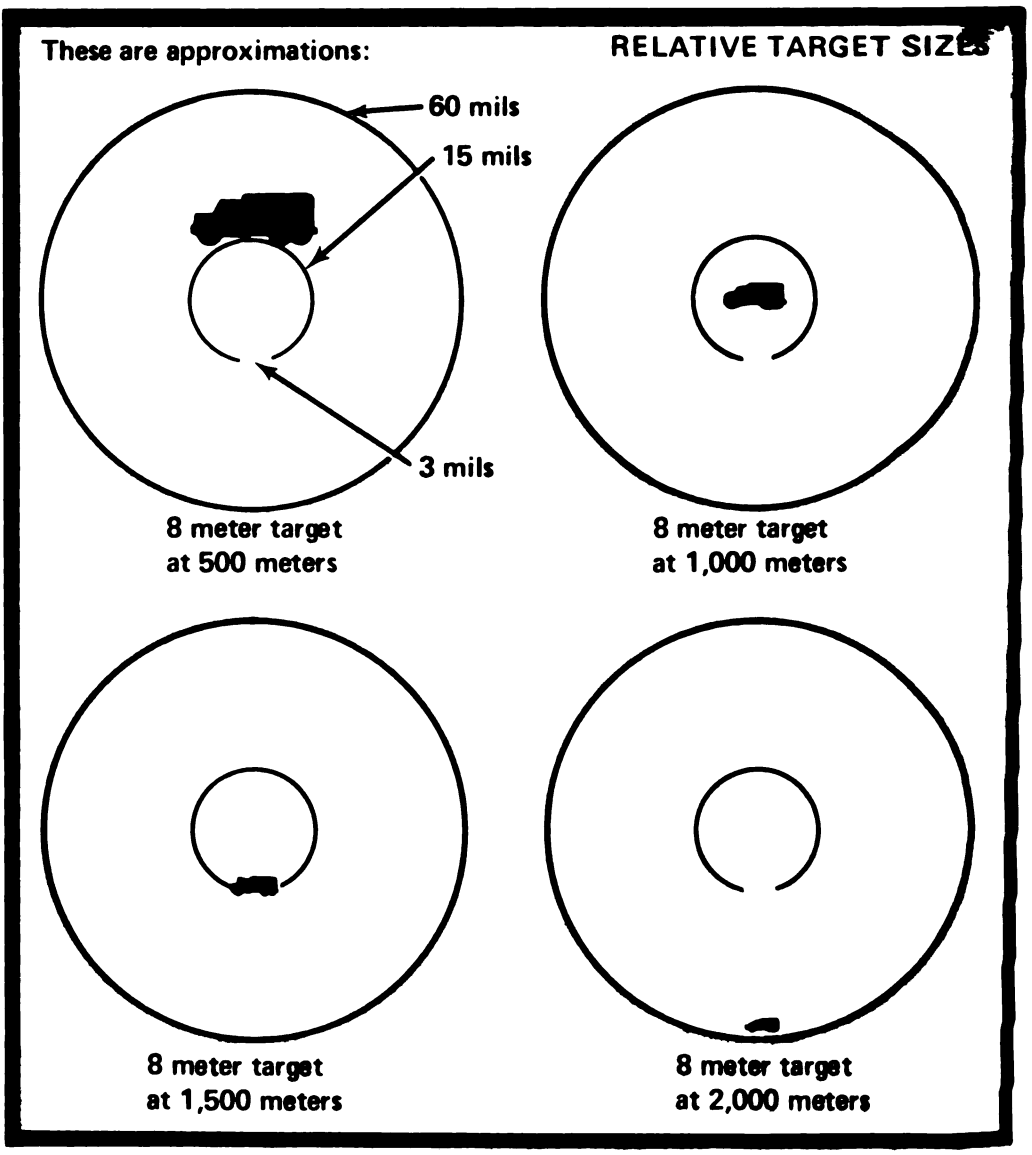
FIRING – CONTINUED

GROUND MODE (NORM & STATIC)

The following reticle patterns are approximations of target size and sight pictures for various ranges.



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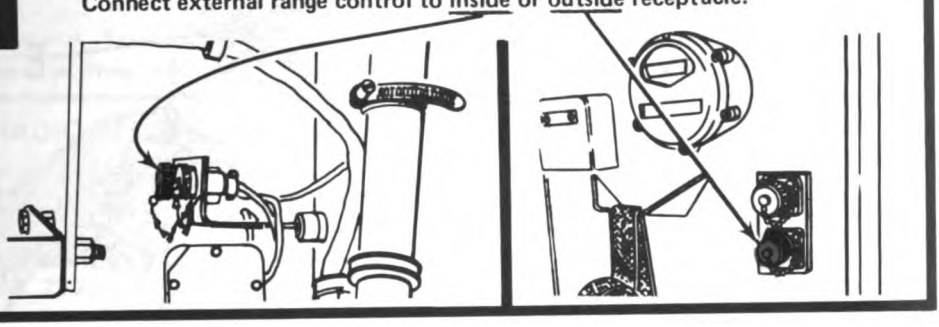
FIRING – CONTINUED

EXTERNAL MODE

1 Do your PREPARATION FOR FIRING (page 2-96).

2 Set distribution box NORM-STATIC-TEST switch to NORM.

3 Connect external range control to inside or outside receptacle.



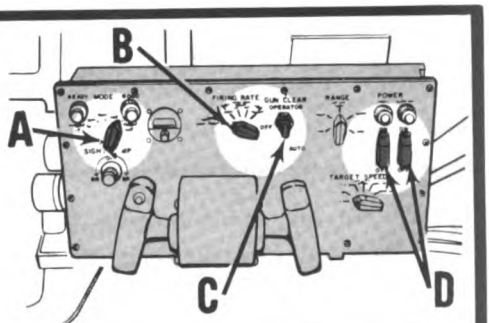
4 Check that sight is caged by rotating the CAGED knob clockwise to its stop.

5 Set MODE select switch (A) to EXT.

Set FIRING RATE switch (B) to HI-BURST LIMIT (high rate) or LO-NO BURST LIMIT (low rate).

Set GUN CLEAR switch (C) to AUTO.

Set SYSTEM and GUN POWER switches (D) to ON.



6 Turn sight CAGED knob fully counterclockwise to uncage sight.

NOTE: - Firing in external mode requires a second man to operate the external range control.

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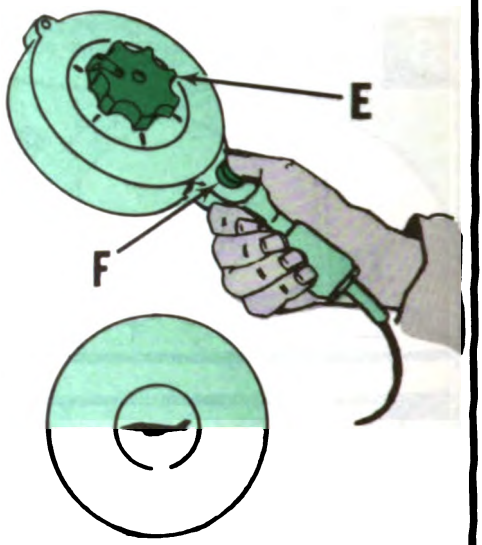
FIRING – CONTINUED

EXTERNAL MODE Continued

7 When target is observed, two things must be accomplished at the same time:

- The external range setter sets the METER X 100 knob (E) to the estimated range of target and depresses the ready-to-fire pushbutton switch (F). Range setter continues to change setting of METERS X 100 knob as the range changes.
- Press either grip assembly action switch and hold sight cage button with left thumb. Position mount so that target is in center of inner reticle. With target in center of inner reticle, release sight cage button and start tracking smoothly.



8

WARNING

Observe warnings and know procedures on cook-offs, hangfires, and stoppages (page 2-112).

9 When ready to fire indicator (G) is lit, tracking is smooth, and target is centered in reticle, depress trigger to fire cannon.

10 If firing in low rate, release trigger to stop firing. Do not attempt to fire a burst of less than 10 rounds. If firing in high rate, keep trigger depressed until cannon stops firing. If more than one burst is desired, depress trigger again.

END

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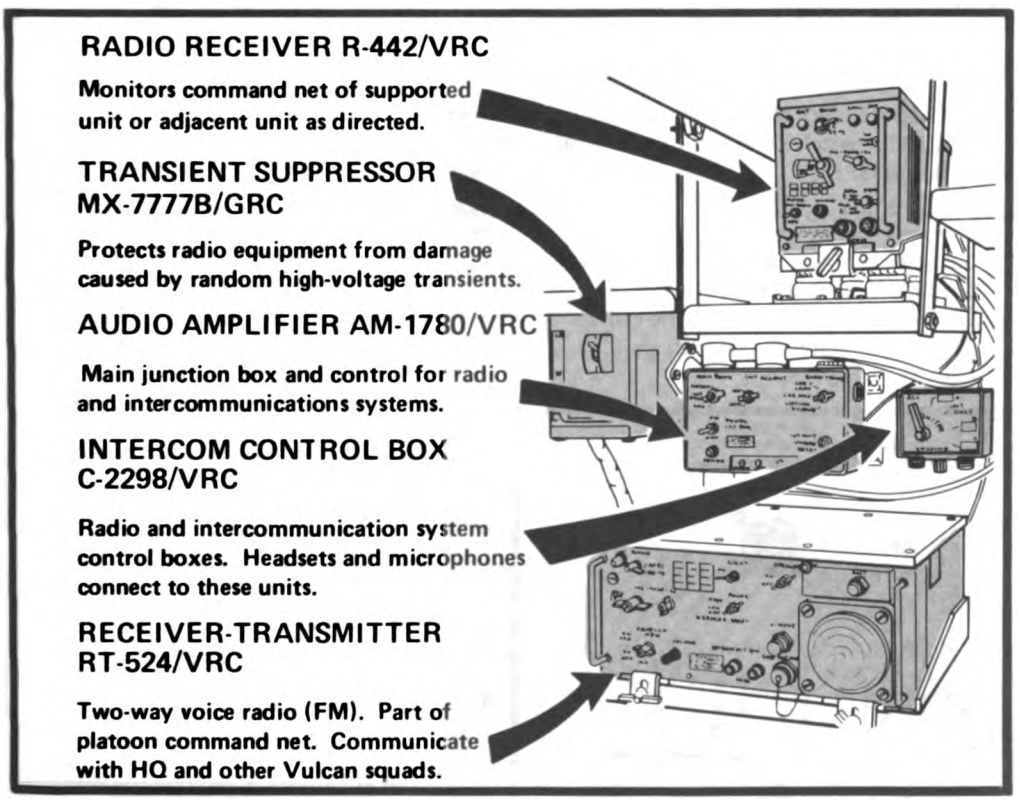
SECTION III. OPERATING AUXILARY AND SUPPORT EQUIPMENT

2-25. Operating instructions for auxiliary support equipment are contained in this section. Maintenance instructions for these items are contained in Chapter 4.

RADIO AND INTERCOMMUNICATION EQUIPMENT

2-26. General. Your radio and intercommunication equipment are interconnected to function as an integrated system.



2-27. Radio Set AN/VRC-47. The set consists of receiver-transmitter RT-524/VRC auxiliary receiver R-442/VRC, a separate antenna for each, and miscellaneous mounting hardware. For a complete description of this equipment and operating instructions, refer to TM 11-5820-401-12.

IMPORTANT: DO NOT transmit with receiver-transmitter RT-524/VRC while a target is being tracked or engaged.

2-28. Intercommunication Set AN/VIC-1(V). This set consists of audio amplifier AM-1780/VRC and three intercom control boxes C-2298/VRC. One control box is provided for the squad leader, one for the driver and one for the senior gunner. For a complete description of this equipment and operating instructions, refer to TM 11-5830-340-12.

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2-29. Transient Suppressor MX-7777B/GRC. Prevents random high-voltage transients from damaging the radios. Thermal switches trip circuit breakers and cut off input power. Circuit breaker switch (1) must be reset to ON to reconnect the power. The covered BATTLE OVERRIDE switch (2) is used during emergency conditions to bypass the suppressor. However, the radios are unprotected in this mode. For a complete description of the suppressor see TM 11-5915-224-14.

CAUTION: Always keep BATTLE OVERRIDE switch (2) off and circuit breaker switch (1) in ON position. If breakers trip, they will not reset until after a two-minute cooling period.

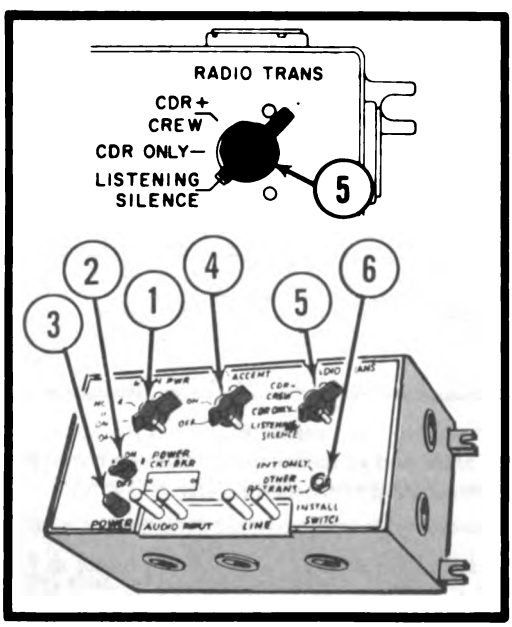
TURN-ON PROCEDURE

For complete operating instructions, refer to TM 11-5820-401-12.

CAUTION: Before starting vehicle engine, make certain that transient suppressor BATTLE OVERRIDE switch (2) is off, circuit breaker switch (1) is ON, and radio MAIN PWR switch (1) is set to OFF.

Intercom Function Only

Set vehicle MASTER SWITCH to ON. Set MAIN PWR switch (1) to INT ONLY and POWER CKT BRK switch (2) to ON. POWER lamp (3) should light.



Radio and Intercom Function

1. Set vehicle MASTER SWITCH to ON. Set MAIN PWR switch (1) to NORM and POWER CKT BKR (2) switch to ON.

2. Turn on receiver-transmitter. POWER lamp (3) should light. Turn on auxiliary receiver. Tune radios to assigned frequency.

3. You will now pick up both radio and intercom signals. To make intercom signals louder, set INT ACCENT switch (4) to ON (at OFF both signals are equal).

4. Set RADIO TRANS switch (5) to one of the following three settings:

   CDR & CREW: Everyone can transmit on receiver-transmitter.

   CDR ONLY: Only commander (squad leader) can transmit.

   LISTENING SILENCE: Nobody can transmit, but everyone still receives.

5. To turn off, set switches (1) and (2) to OFF. This turns off the radios.

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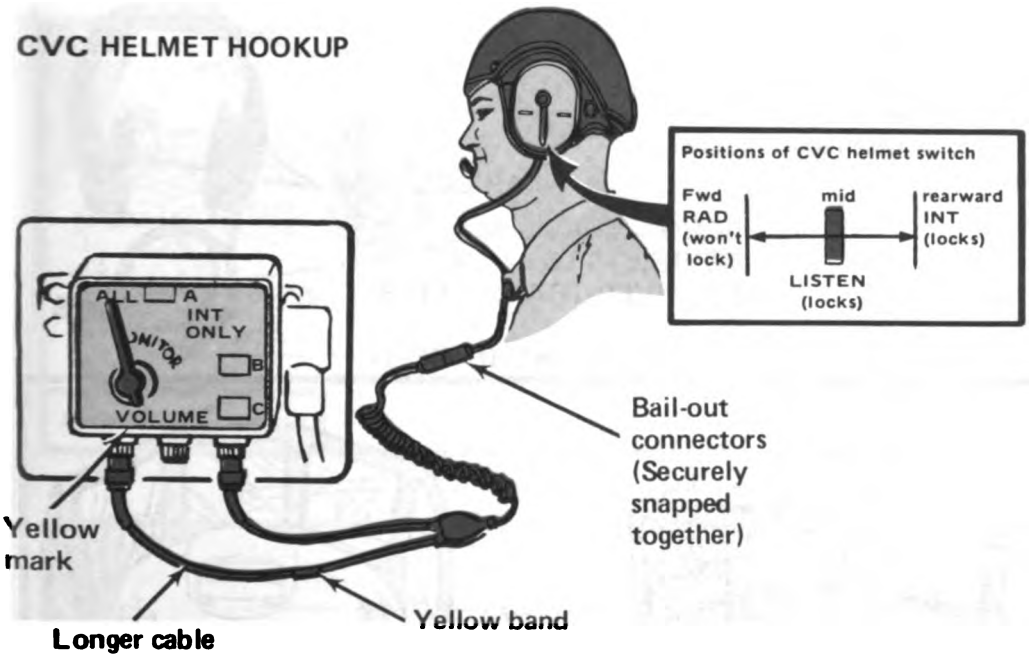
RADIO AND INTERCOMMUNICATION EQUIPMENT – CONTINUED



Control Box Radio and Intercom Functions

1. Set MONITOR switch to ALL or A. To talk on receiver-transmitter, push helmet switch forward and talk into mike; release switch to listen for radio and intercom signals.

2. To listen to radio receiver, set MONITOR switch to B and helmet switch to mid-position.

NOTE: When a crewmember, other than squad leader, is talking on radio and another crewmember starts to talk on intercom, the radio connection is broken.

Control Box Intercom Function

Set MONITOR switch to A, ALL, or INT ONLY. Push helmet switch rearward to talk to another crewman. Set in midposition to listen.

RADIO INTERFERENCE SUPPRESSION

WARNING

Electrical disturbances that interfere with radio reception or disclose the system location to sensitive electrical detectors must be properly suppressed. If excessive noise or interference is encountered during operation of the radio equipment, notify organizational meintenance.

END

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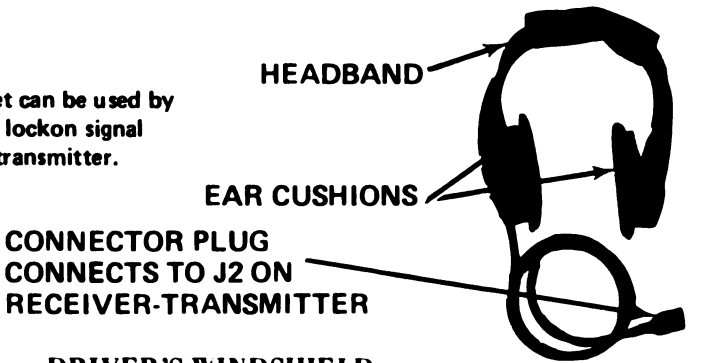
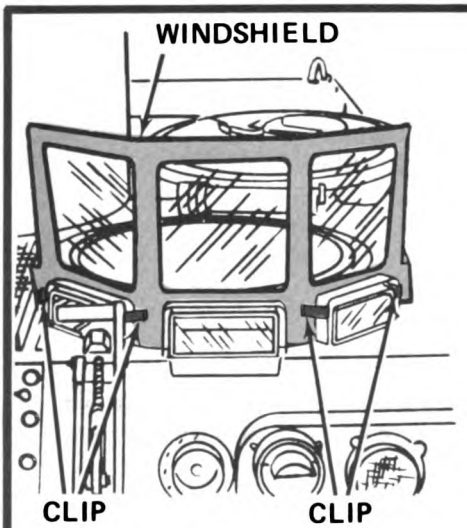
H-251/U HEADSET

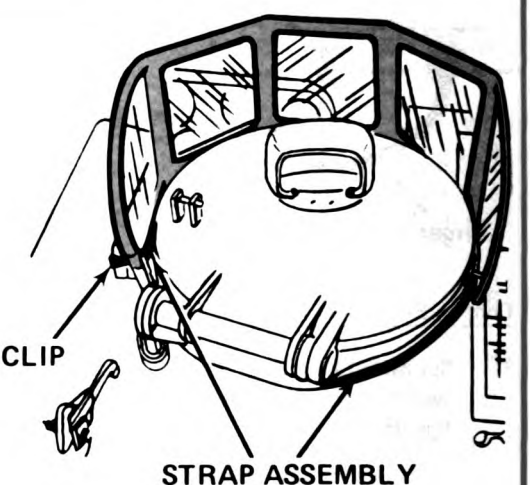
H-251/U HEADSET

The H-251/U headset can be used by operator to hear the lockon signal from radar receiver-transmitter.



DRIVER'S WINDSHIELD





INSTALLATION

1. Position windshield between periscopes and driver's hatch.
2. Attach five metal clips on windshield to periscope guards. There is no clip on right end of windshield.
3. Install strap assembly on windshield and around rear of driver's hatch; tighten strap to secure windshield.

REMOVAL

1. Loosen strap securing windshield to driver's hatch.
2. Disconnect five metal clips from periscope guards.
3. Fold windshield, place in stowage bag, and stow inside vehicle.

IMPORTANT – Use care in handling windshield to avoid damage and scratches to the vinyl plastic windows.

AIR GRILLE CURTAIN

See page 2-60 for installation instructions of air grille curtain.

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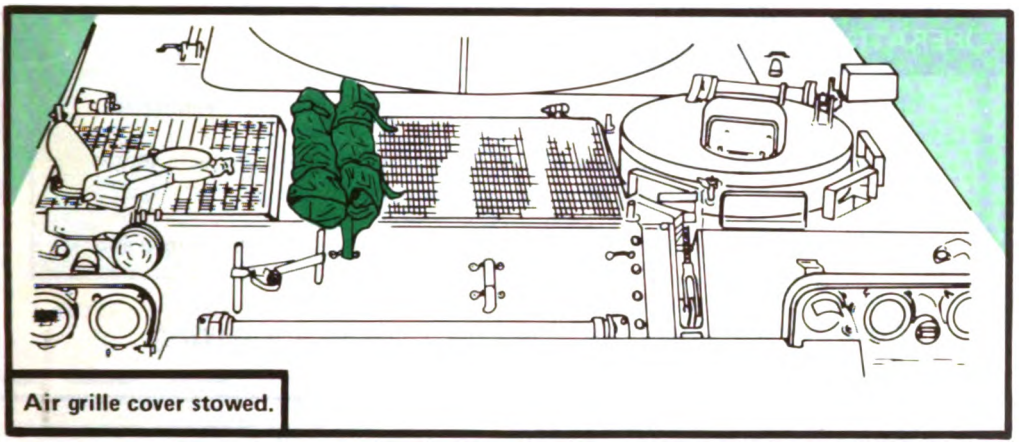
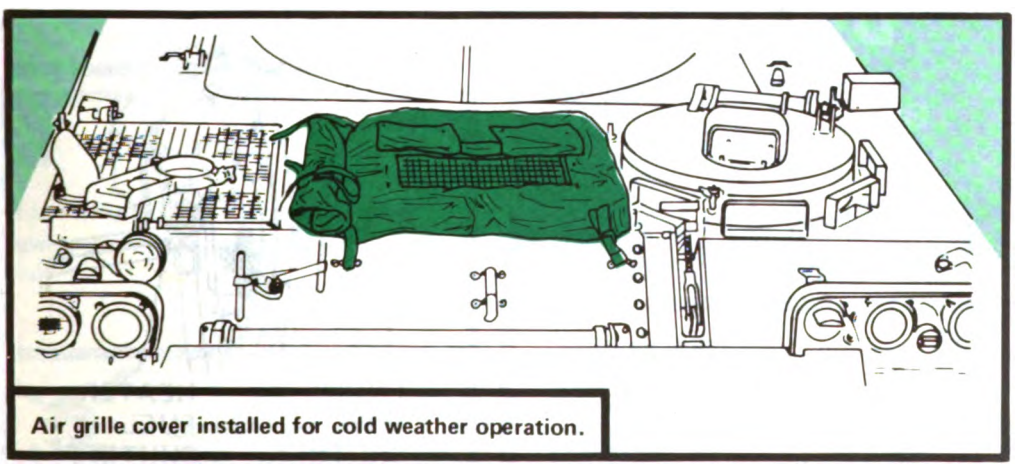
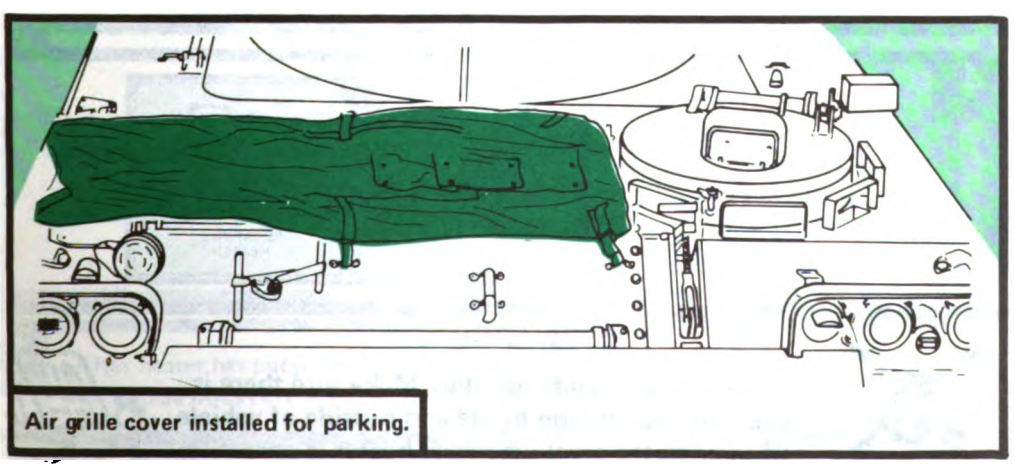
AIR GRILLE COVER



Air grille cover stowed.



Air grille cover installed for cold weather operation.



Air grille cover installed for parking.

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OPERATING PERSONNEL COMPARTMENT HEATER

OPERATING CAUTIONS

DON'T operate heater in an enclosed area unless it is adequately ventilated.

DON'T operate heater for long periods without maintaining adequate ventilation in driver's and personnel compartments.

DON'T turn off vehicle MASTER SWITCH until heater has been purged and turns off.

DO be alert at all times during heater operation for monoxide exposure symptoms.

1

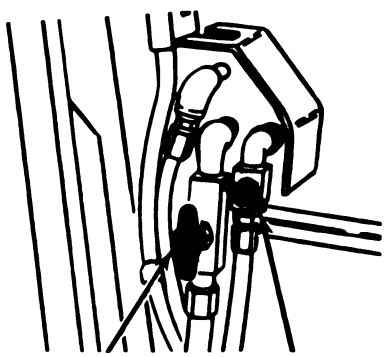
DO your

Before Operation

PMCS

2

Open heater fuel shutoff.



ENGINE FUEL SHUTOFF

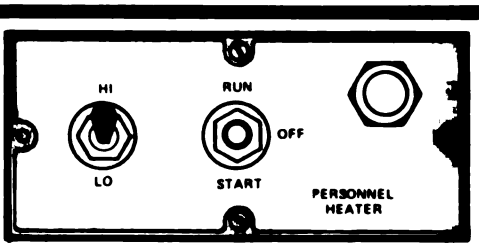
HEATER FUEL SHUTOFF

3

Turn vehicle MASTER SWITCH to ON.

4

Set switch to HI or LO heat.



WARNING

Monoxide gas can be deadly. Make sure there is adequate ventilation inside and outside of vehicle (if in enclosed area) whenever heater is operating.

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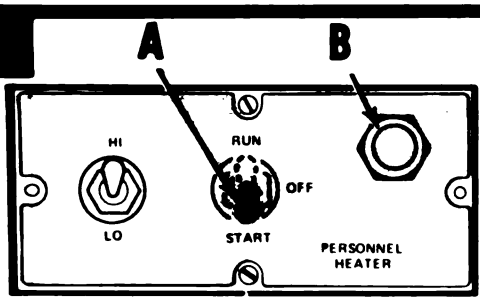
OPERATING PERSONNEL COMPARTMENT HEATER – CONTINUED

5



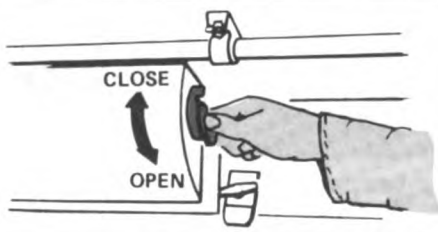
Hold RUN-OFF-START switch (A) to START until heater has ignited, blower speed has increased, and indicator (B) lights. Then set switch (A) from START to RUN without stopping in the OFF position. Indicator (B) remains lit while heater is running.

NOTE: If heater becomes overheated, it will shut down automatically and must be restarted. Wait at least 5 minutes before restarting.

IMPORTANT – If heater fails to start, set RUN-OFF-START switch to OFF. Press indicator (B) lens cover. If indicator lights, repeat step 5 to start heater. If heater does not start on third attempt, refer to troubleshooting procedure (table 4-2).

6

If heater is to be operated unattended, open personnel compartment air inlet vent.

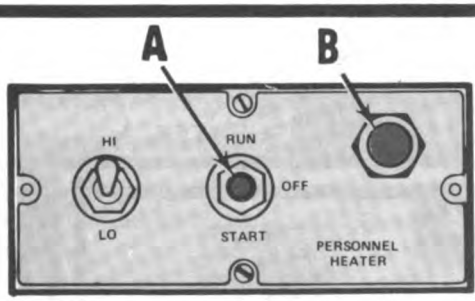


WARNING

Do not turn off MASTER SWITCH until heater has been purged and turns off.

7

To stop heater, set RUN-OFF-START switch (A) to OFF. Indicator (B) will remain lit and heater will run until heater is purged.



8

After heater has purged and turns off, set vehicle MASTER SWITCH to OFF.

9

Close heater fuel shutoff cock.

END

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OPERATING ENGINE COOLANT HEATER

OPERATING CAUTIONS

DON'T use engine coolant heater unless temperature is below -25° F.

DON'T use vehicle electrical equipment while coolant heater is operating.

DON'T start or run engine with coolant heater operating.

DON'T turn off vehicle MASTER SWITCH until coolant heater has been purged and turns off.

DO stop coolant heater and start vehicle engine every 12 hours to recharge vehicle batteries.

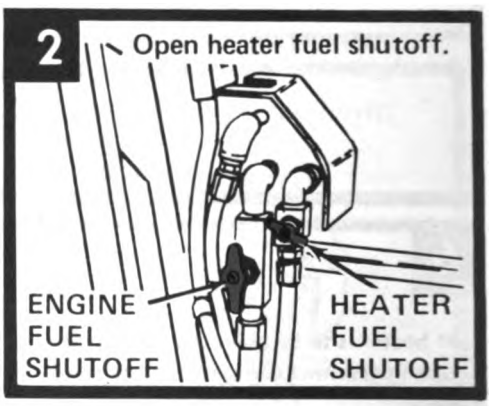
1

DO your

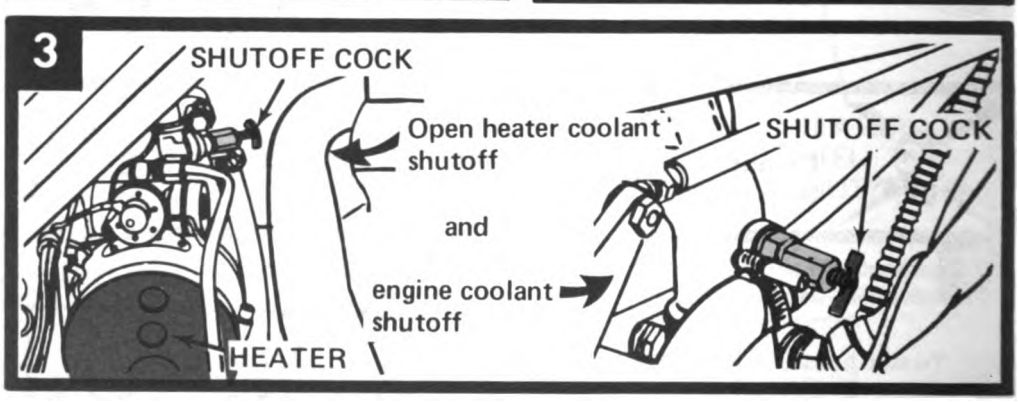
Before Operation

PMCS

2



3



4

Turn vehicle MASTER SWITCH to ON.

5

Set switch to HI or LO heat.

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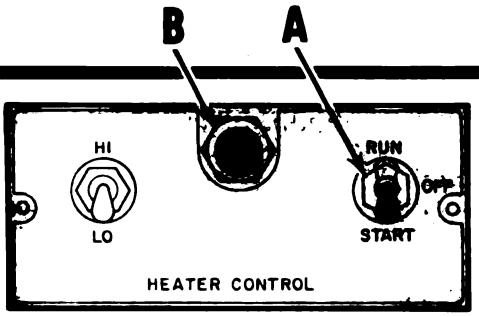
OPERATING ENGINE COOLANT HEATER – CONTINUED

6



Hold RUN-OFF-START switch (A) to START until indicator (B) lights. Then set switch (A) from START to RUN without stopping in the OFF position. Indicator (B) remains lit while heater is running.

NOTE - If heater becomes overheated, it will shut down automatically and must be restarted. Wait at least 5 minutes before restarting.

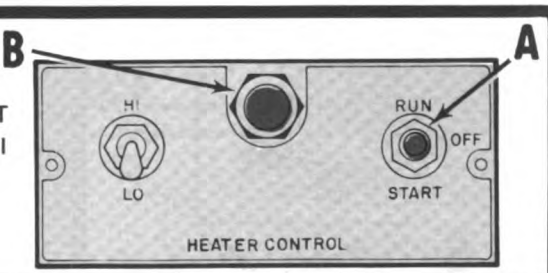
IMPORTANT – If heater fails to start, set RUN-OFF-START switch to OFF. Press indicator (B) lens cover. If indicator lights, repeat step 6 to start heater. If heater does not start on third attempt, refer to fault isolation procedure (table 4-2).

WARNING

Do not turn off MASTER SWITCH until heater has been purged and turns off.

7

To stop heater, set RUN-OFF-START switch (A) to OFF. Indicator (B) will remain lit and heater will run until heater is purged.



8

After heater has purged and turns off, set vehicle MASTER SWITCH to OFF.

9

Close both coolant shutoff cocks.

Close heater fuel shutoff cock.

END

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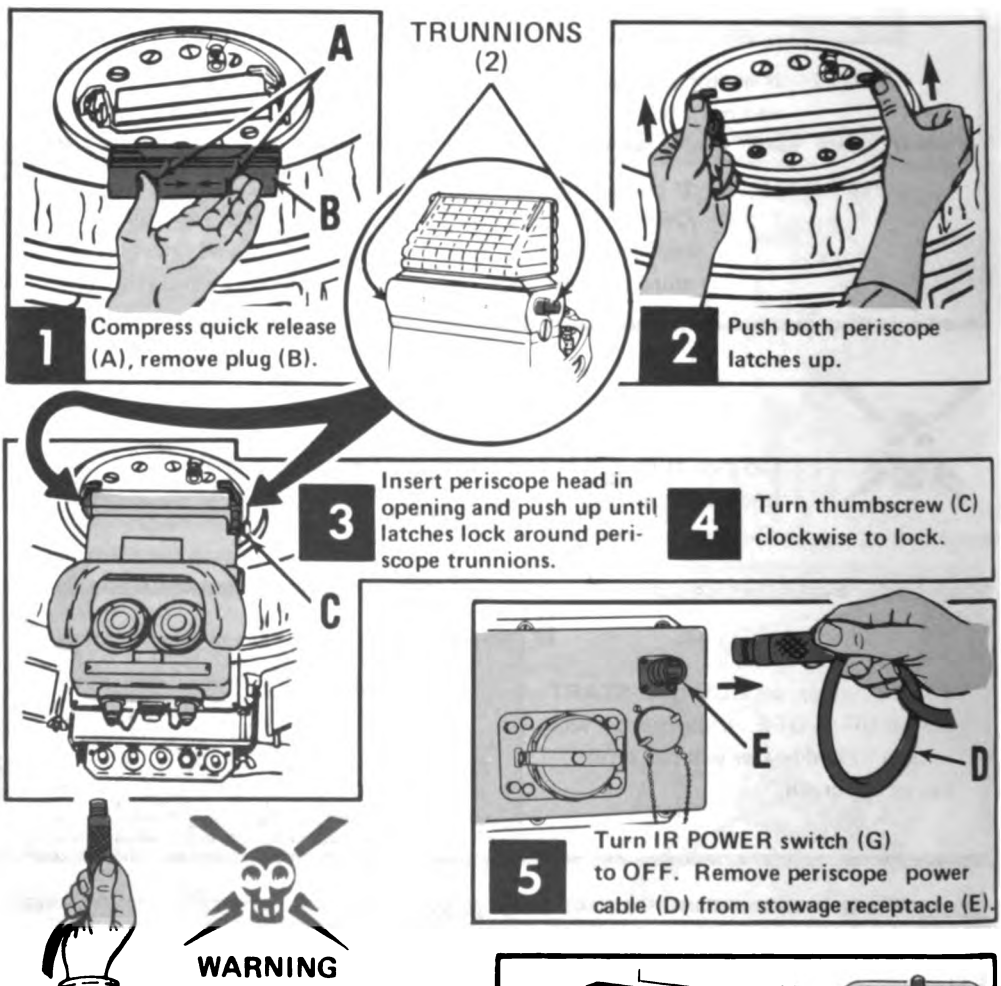
M19 PERISCOPE

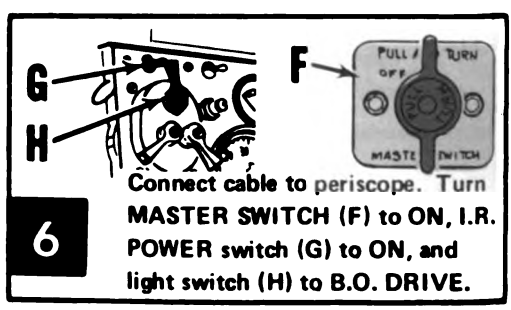
INSTALLATION/REMOVAL (Removal is the reverse of installation)

The M19 periscope is used for blackout driving with infrared headlights. When not in use, it is stowed on hull wall to left of driver.
IMPORTANT - Damage to periscope will occur if lenses are exposed to direct sunlight. Always remove and stow periscope before daylight. Do not open driver's hatch with periscope installed.



WARNING

Power cable must be disconnected/connected to periscope only when power is turned off. After power is off, wait one minute before disconnecting cable from periscope. DON'T touch end of cable. Voltage could exceed 16,000 volts. Install cable on stowage receptacle immediately.



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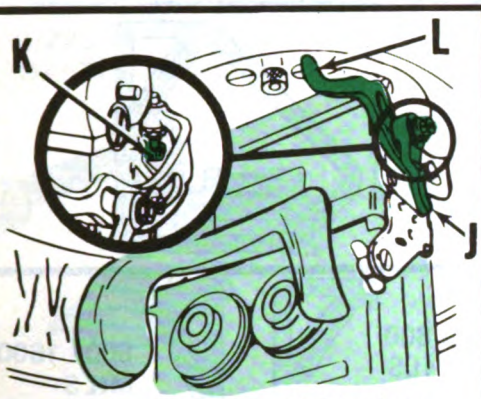
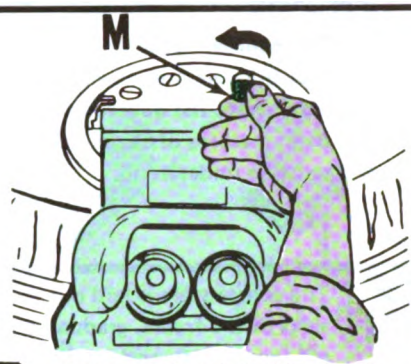
M19 PERISCOPE – CONTINUED

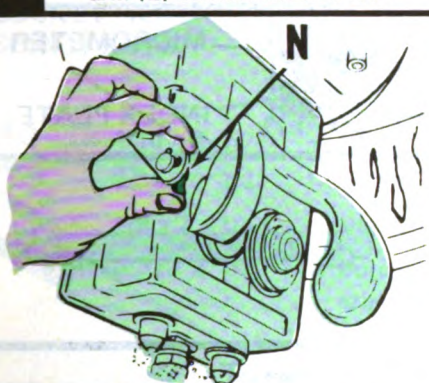
ADJUSTMENTS



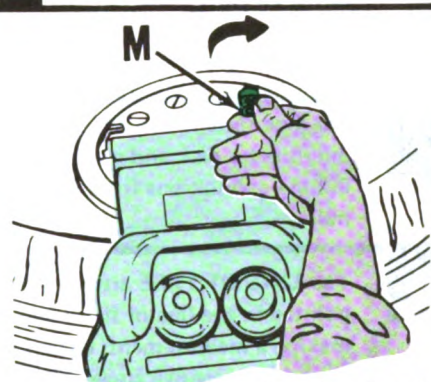
7 Loosen elevation locking lever (J) and set adjusting knob (K) so that both ends of elevation arm (L) contact hatch cover.



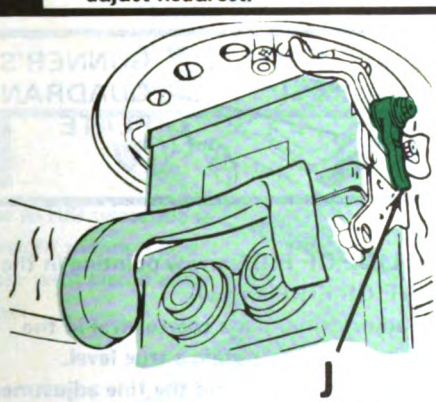
8 Loosen azimuth locking knob (M).



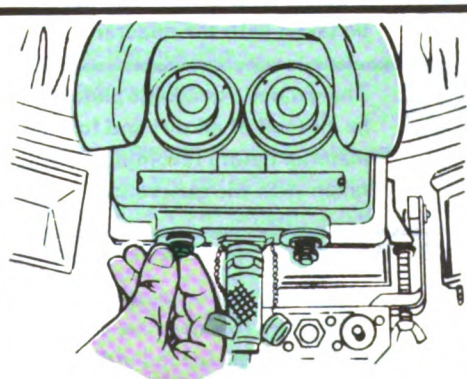
9 Loosen clamping screw (N) and adjust headrest.



10 Adjust periscope in azimuth and tighten azimuth locking knob (M).



11 Adjust periscope in elevation and tighten locking lever (J).



12 Focus each eyepiece with adjusting screw. Loosen lock nut as shown, use screwdriver to adjust screw, and retighten lock nut.

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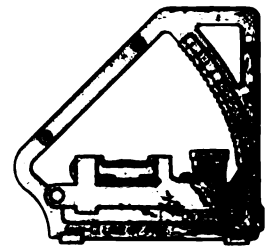
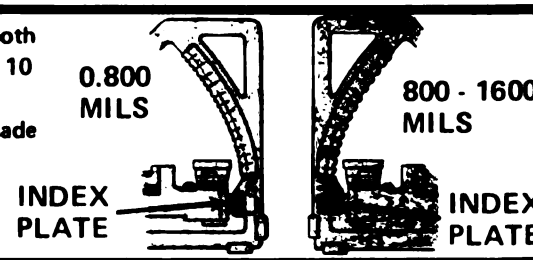
M1A1 GUNNER'S QUADRANT

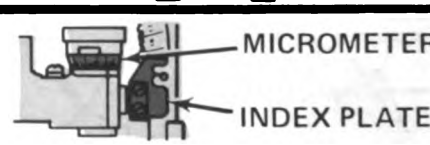
The gunner's quadrant is used to measure angles of elevation in mils. To operate the quadrant a few basic features of the quadrant must be understood.



1 The coarse scale is laid out on both sides of the frame, graduated in 10 mil increments, and numbered every 50 mils. The reading is made at the index plate.

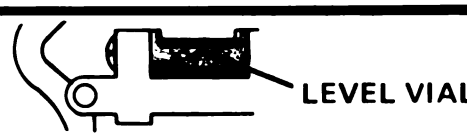


2 The fine scale is laid out on a micrometer dial, and graduated in 0.2 mil graduations from 0 to 10 mils.

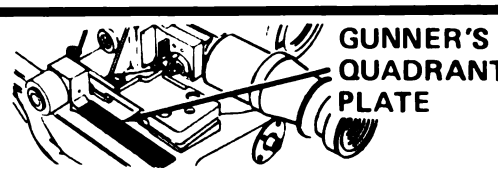


3 The LINE OF FIRE arrow must be pointed in the line of fire when making a measurement, except when measuring negative angles. For this, reverse the LINE OF FIRE arrow.

4 The level vial with bubble must indicate level before readings can be taken with the quadrant.



5 The gunner's quadrant plate must be cleaned of all dirt and foreign material before readings can be taken with the quadrant.



TO OPERATE THE GUNNER'S QUADRANT

1. Place quadrant on quadrant plate with the LINE OF FIRE arrow pointing in the line of fire (for negative angles, reverse LINE OF FIRE arrow).
2. Release spring loaded index plate. Coarse adjust to obtain a coarse level in the level vial, then fine adjust by turning the micrometer to obtain a true level.
3. Make certain that the color is the same on both the coarse and the fine adjustment areas, then add the coarse and fine readings. The sum of the coarse and fine readings equal the mils of the angle measured. For further information refer to TM 9-1290-200-14.

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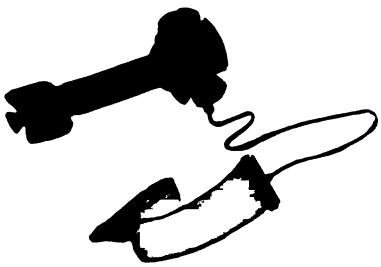
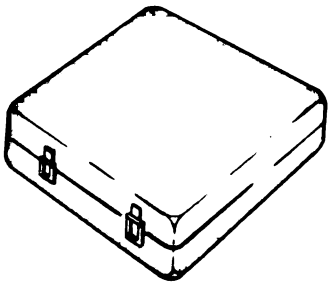
BORESIGHT KIT

MUZZLE ADAPTER



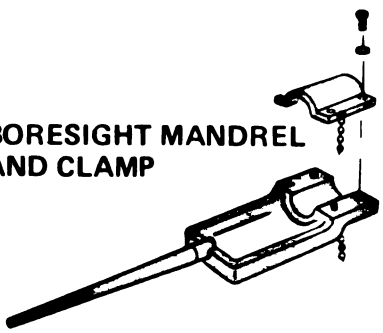


BORESIGHT KIT

M109 TELESCOPE

MOVABLE COLLAR

BORESIGHT MANDREL AND CLAMP



SOCKET HEAD SCREW KEYS

USES

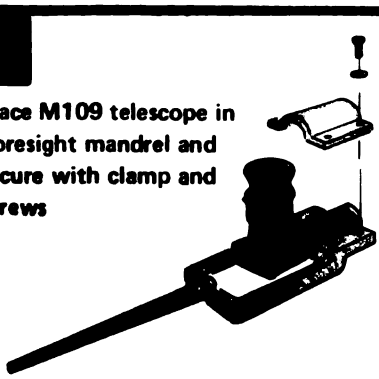
1/16 x 2 29/32	–	NONE
3/32 x 2 3/32	–	NONE
1/8 x 2 11/32	–	NONE
5/32 x 2 1/2	–	Boresight mandrel and M61 sight azimuth and elevation adjustments.

NOTE

Movable collar must be positioned next to the shoulder of the clamping surface. If not notify organizational maintenance.

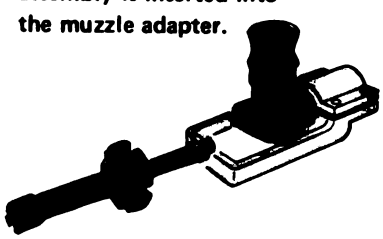
1

Place M109 telescope in boresight mandrel and secure with clamp and screws



2

In use, the muzzle adapter fits into a cannon barrel and the telescope and mandrel assembly is inserted into the muzzle adapter.



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AN/TVS-2B NIGHT VISION SIGHT

The night sight is mounted to the right of the M61 sight and may be installed or removed by the crew. Detailed instructions on operation and maintenance are contained in TM 11-5855-202-13.

WARNING

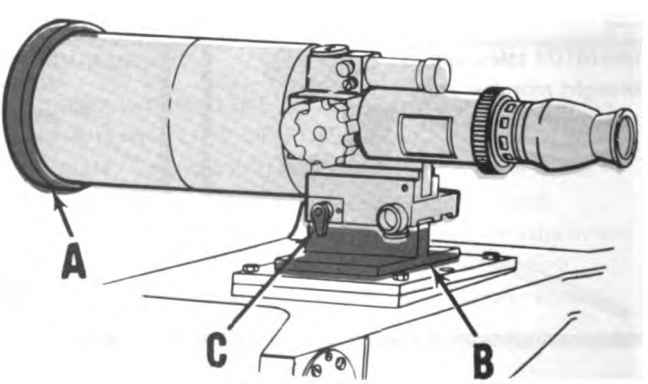
A residual charge of approximately 45,000 volts exists after power is turned off. Always wait five minutes after shutdown before removing battery.

INSTALLATION

1. Open PRESSURE EQUALIZER according to instruction plate before releasing carrying case latches.
2. Open case and remove sight from case. Install battery.
3. IMPORTANT - Do not remove adjustable boresight cover (A) during daylight, and make sure aperture of cover is closed. Sunlight or other intense light can cause damage.
4. Install sight on dovetail mount (B) to right of M61 sight and push forward to stop.
5. Secure sight by tightening locking knob (C) on the left of the mounting.
6. Boresight according to page 3-41.

REMOVAL

1. IMPORTANT - Do not remove adjustable boresight cover (A) during daylight, and make sure aperture of cover is closed. Sunlight or other intense light can cause damage.
2. Unlock knob (C) and remove sight from dovetail mount (B).
3. IMPORTANT - Make sure that both sight and sight case are completely dry before storing sight in case.
4. Remove battery and stow in case. Place sight in case. Close and latch cover.



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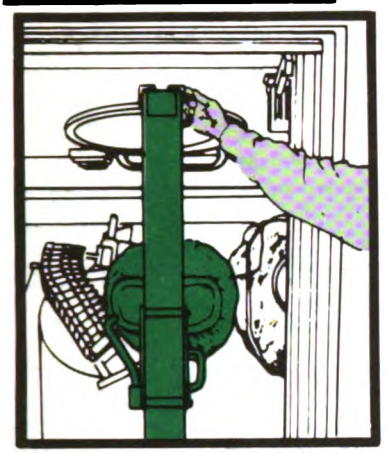
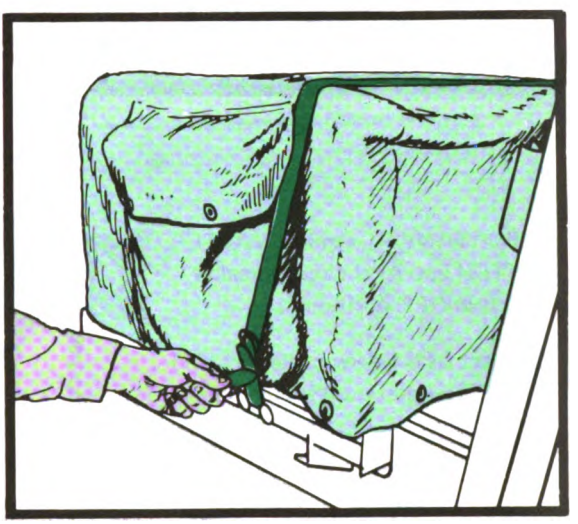
AUXILIARY POWER UNIT (APU)

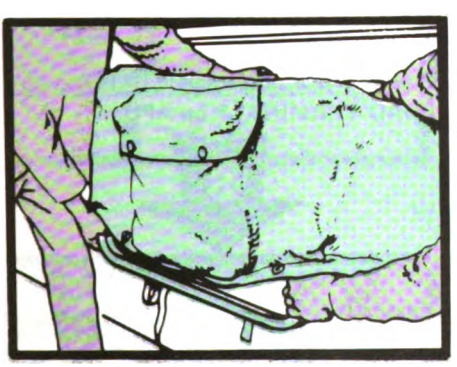
SETTING UP THE APU



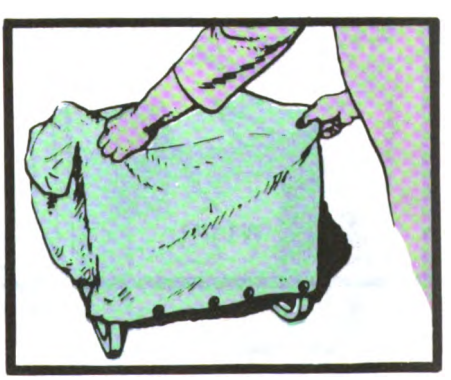
1 Remove two quick release pins (top and bottom) and remove commander's seat and post assembly.



2 Unfasten two tiedown straps securing APU.



3 Remove APU from stowage rack (two people required) and place APU on vehicle deck.



4 Remove APU cover and stow.

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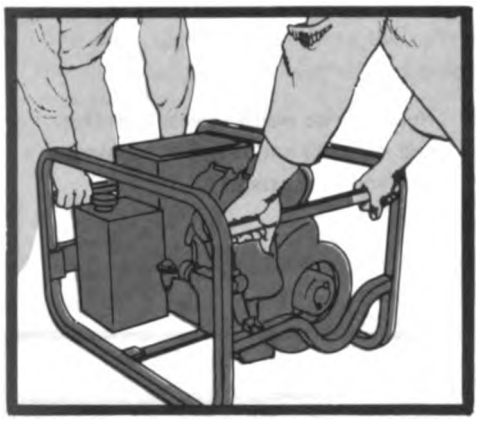
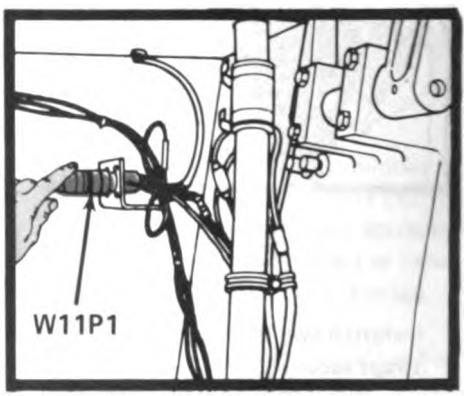
AUXILIARY POWER UNIT (APU) – CONTINUED



5 **Remove APU from vehicle (two people required).**



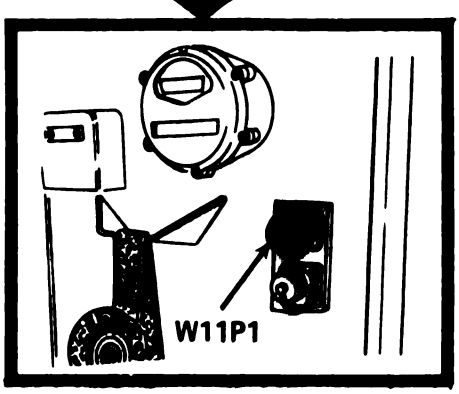
6 **IMPORTANT – Vehicle MASTER SWITCH and APU circuit breaker switch in OFF position.**

Connect APU power cable (W11P1) to APU receptacle on inside right rear of vehicle

OR

connect to APU receptacle on outside right rear of vehicle.

7

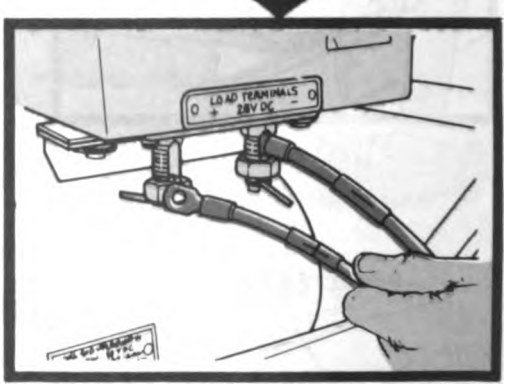


CAUTION

Make sure that polarity marks on cable match polarity marks at terminals.

Connect APU power cable (W11) to LOAD TERMINALS on APU.

8



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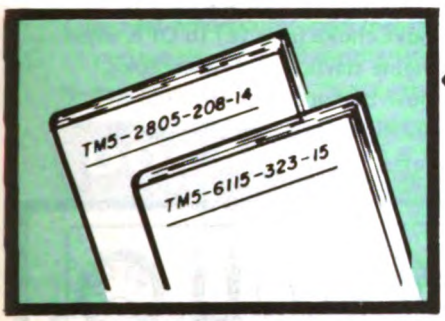
AUXILIARY POWER UNIT (APU) – CONTINUED

OPERATING THE APU

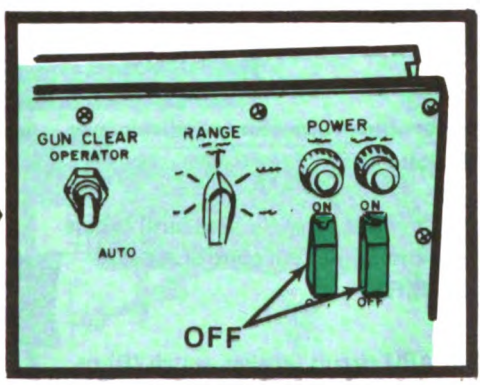
WARNING

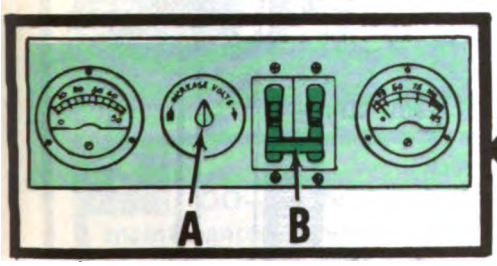
Do not operate APU until you are familiar with operating procedures in TM 5-6115-323-15. The APU produces ample electrical power to cause injury and pain if normal safety precautions are not observed.



9 Do your daily preventive maintenance checks and services (PMCS). See TMs stowed in APU cover pocket.

10 SYSTEM POWER and GUN POWER switches on control panel set to OFF position.





11 Set APU variable resistor knob (A) to vertical. Set APU circuit breaker switch (B) to OFF.

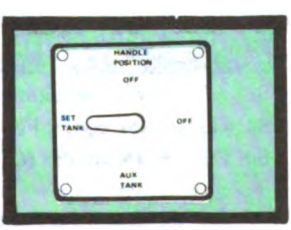
WARNING

Do not fill fuel tank while APU is running. Also, make metal to metal contact between container and fuel tank when filling.

Set fuel valve handle to OFF. Fill tank with fuel.
Set fuel valve handle to SET TANK.

NOTE - AUX TANK position is used only if external fuel tank is connected.

12



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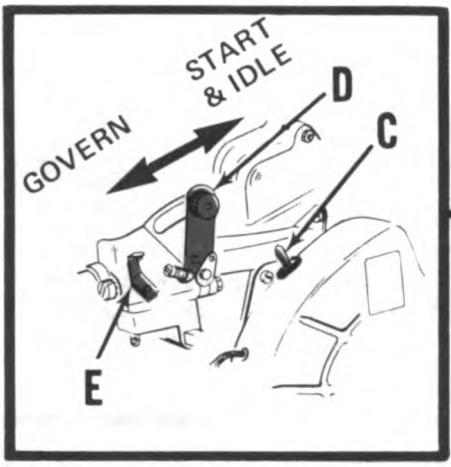
AUXILIARY POWER UNIT (APU) – CONTINUED



13

Set OFF-RUN switch (C) to RUN.
Set carburetor control (D) to START & IDLE.
Set choke lever (E) to CHOKE (if engine is cold).
Crank engine with starter rope and move choke lever (E) to OFF when engine starts. Don't overchoke.
Move carburetor control (D) to GOVERN and lock after engine starts.

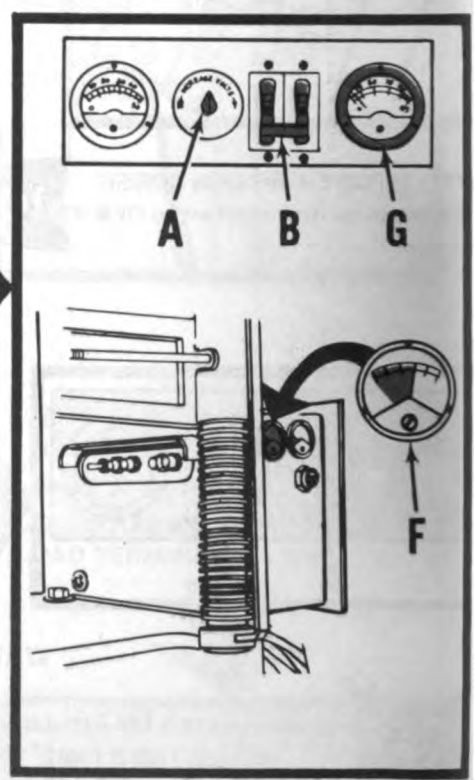
CAUTION

Never allow voltmeter to indicate over 29 volts.

NOTE

Don't adjust or apply load until engine runs smoothly with control set at GOVERN.

14



Set APU circuit breaker switch (B) to ON.
Adjust variable resistor knob (A) until VOLTS meter (F) on distribution box indicates 28-29 volts.
If APU circuit breaker switch trips when load is applied, and load current meter (G) indicates over 100%, the batteries need to be charged (see page 3-95).

CAUTION

If circuit breaker switch (B) trips for an unknown reason, reset it.
If it trips again, notify organizational maintenance.

SHUTTING DOWN THE APU

- Set APU circuit breaker switch (B) to OFF.
- Set carburetor control (D) to START & IDLE.
- Set OFF-RUN switch (C) to OFF.

For further information refer to TM 5-6115-323-15 and TM 5-2805-208-14.

END

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SECTION IV.
OPERATING UNDER UNUSUAL CONDITIONS

2-30. Introduction. When operating under unusual conditions, there are certain things that must be done. The DOs and DON'Ts that follow are important. They must be observed so that you and your equipment will perform properly.

OPERATING A WINTERIZED VEHICLE IN EXTREME COLD (0° to -65°F)

2-31. General. Extreme cold thickens lubricants, freezes batteries, cracks insulation, stops fuel vaporization, and makes materials easier to damage. In addition to complete winterization and good maintenance, the following DOs and DON'Ts will keep you going in rugged artic weather. Start engine according to page 2-45.

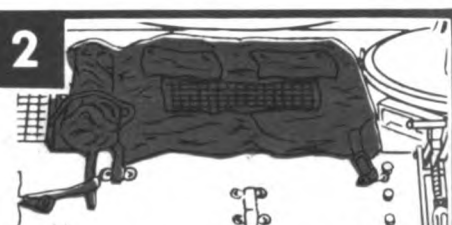
DOs AND DON'Ts IN EXTREME COLD

BEFORE OPERATING DOs . . . .

1

DO your Before Operation PMCS

2



DO—Install air intake grill cover and adjust for conditions (page 2-131).

3

DO—Notify organizational maintenance for repositioning of mount battery taps if necessary

4

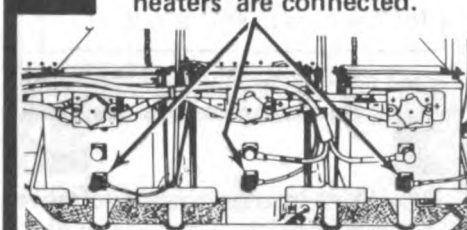
DO—Be aware of the way cold weather affects your vehicle.

5

DO—Purge fuel in air box heater when changing to arctic fuel by loosening line at pressure indicator. When indicator shows no pressure, tighten line. Recharge accumulator (page 2-45).

6

DO—Make sure battery heaters are connected.



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DOs AND DON'Ts IN EXTREME COLD – CONTINUED

BEFORE OPERATING DON'Ts

1

DON'T – Touch bare metal or fuel with hands. Wear gloves.

2

DON'T–Expose sight and fire control instruments to sudden temperature changes.

OPERATING DOs

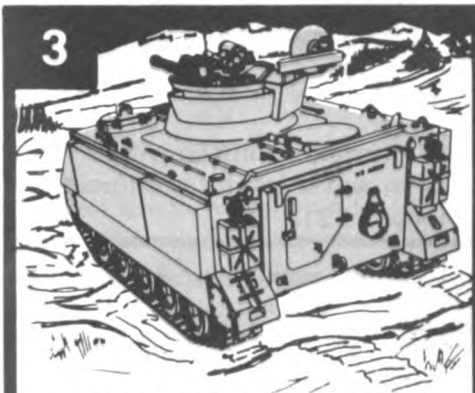
1

DO–Operate fire control system in standby for 15 minutes between 32°F and -40°F and for 30 minutes between -40°F and -65°F before pre-fire checks.

2

DO–Be cautious when starting vehicle after prolonged shutdown. After engine warmup place shift lever into range 1 and drive slowly for about 100 meters to heat lubricants in gears. Refer to TM 21-306.

3



DO–Climb on heavily crusted snow by reducing engine speed and shift into range 1 to move without slipping.

Select best transmission range for traction in soft snow.

4

DO–On hills, drive straight up and down to equalize track load on snow.

5

DO–Shift into best range to move steadily on ice. Decelerate engine when skidding occurs.

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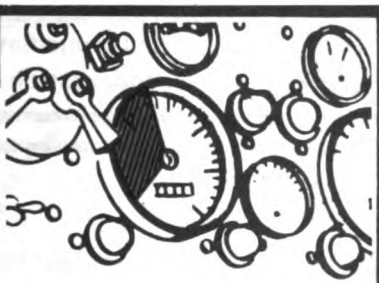
DOs AND DON'Ts IN EXTREME COLD – CONTINUED

OPERATING DON'Ts

1



CAUTION – DON'T let tachometer reading go over 2975 rpm under any circumstances.

2 DON'T–Breathe on optical surfaces. Condensation will freeze.

3

DON'T–Make sharp turns in snow.

4

DON'T–Attempt to start engine with temperature under -25°F if coolant heater has not been operating or external heat has not been applied. Contact organizational maintenance.

SHUTDOWN DOs

1 DO–Park vehicle in a sheltered spot out of wind. If no shelter, park rear of vehicle towards the wind.

2 DO–Cover ends of periscopes to protect from snow and ice.

3 DO–Clean and lubricate breech bolts per LO 9-2350-300-10.

4

DO – Cover cannon when not in use.

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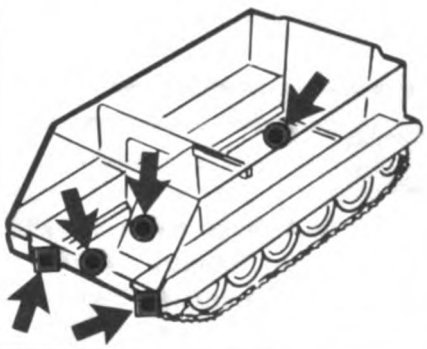
DOs AND DON'Ts IN EXTREME COLD – CONTINUED

SHUTDOWN DOs – Continued

5 DO–Remove drain plugs when water collects in hull.

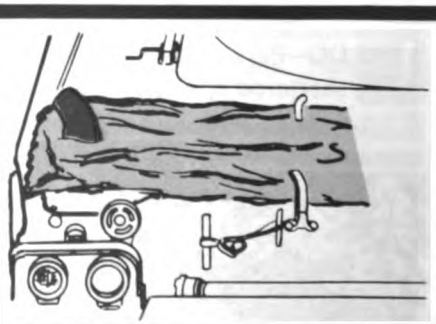


6 DO–Refuel immediately to reduce condensation.

7 DO–Start engine coolant heater and check proper operation right after engine shutdown. Stop coolant heater and start engine every 12 hours to recharge batteries (page 2-134).

8 DO–Clean off all snow, ice, and mud as soon as possible after operation.

9 DO–Install grille covers. Leave engine exhaust pipe UNCOVERED.



10 DO–"After operation procedures " (PMCS).

SHUTDOWN DON'Ts

1 DON'T–Run engine while coolant heater is operating.

2 DON'T–Operate lights or electrical equipment while coolant heater is operating.

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DOs AND DON'Ts IN EXTREME COLD – CONTINUED

SHUTDOWN DON'Ts – Continued

3

WARNING

DON'T – At any time, turn MASTER SWITCH to OFF until coolant heater is purged and turns off (page 2-134).

4

DON'T–Over lubricate breech bolts (page 2-147).

OPERATING VEHICLE IN EXTREME HEAT

2-32. General. Rust and fungus thrive in hot, humid weather. Materials dry and crack, battery liquid and oil evaporate faster. Special care will insure dependable operation of your vehicle in extreme heat.

DOs AND DON'Ts IN EXTREME HEAT

DOs

1

DO your Before Operation PMCS

2

DO–Use lower gear ranges whenever possible.

3

DO–Park vehicle under cover from sun or use tarps if shelter is not available.

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DOs AND DON'Ts IN EXTREME HEAT – CONTINUED

DOs – CONTINUED

4 DO–Make frequent inspections, clean and lubricate to prevent deterioration. See LO 9-2350-300-10.

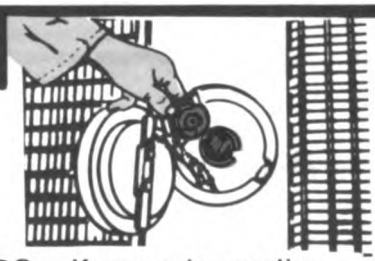
5 DO–Protect fire control system from direct rays of sun as much as possible.

6 DO–Keep sun off ammo.

WARNING

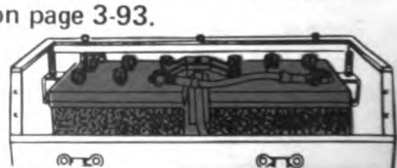
DO NOT – Smoke, handle ammo, wear rings, or drop tools when servicing batteries (page 3-93).

7



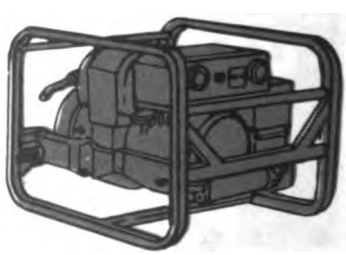
DO – Keep engine cooling system filled to within 3 inches from the top of filler.

8 DO–Check fluid in chassis batteries (2) daily. Refill with pure distilled water. Use rain or drinking water if distilled water is not available. IMPORTANT – Use procedure on page 3-93.



9 DO – Notify organizational maintenance to check the level of the electrolyte in the mount battery cells daily.

10 DO–Store and operate APU in a shaded location. Allow free flow of air around unit (refer to TM 5-6115-323-15).



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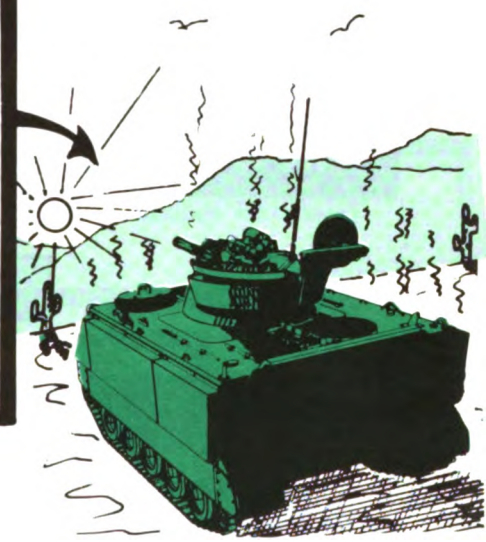
DOs AND DON'Ts IN EXTREME HEAT – CONTINUED

DON'Ts

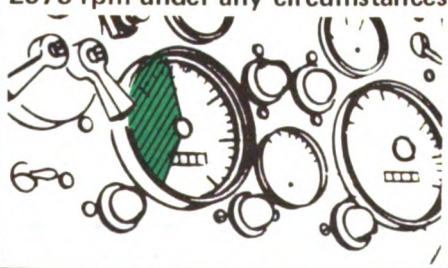
1 DON'T—Overheat engine by driving continuously at high speeds. Long hill climbs will cause overheating. Keep an eye on engine TEMP F gage.



2 DON'T—Use dirty or high mineral content water in cooling system--causes scale, rust, and clogging.

3 DON'T – Remove radiator cap on overheated cooling system until pressure has been relieved. WARNING

4 CAUTION – DON'T let tachometer reading go over 2975 rpm under any circumstances.



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OPERATING VEHICLE IN DUSTY OR SANDY AREAS

2-33. General. Blowing dust and sand will erode external finishes and affect your vehicle in many other ways. Sand mixed with grease and oil forms a grinding agent that will cause failure of moving parts. Dust and sand are enemies of your vehicle.

DOs AND DON'Ts IN DUSTY OR SANDY AREAS

DOs

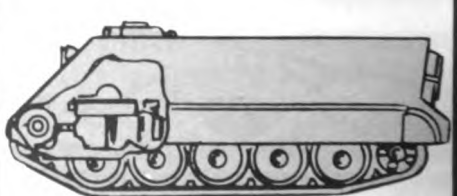
1 DO your Before Operation PMCS

2 DO—Slow down and use lower gear range to move steadily in sand.

3 DO—Park under shelter or use tarps, if available.

4 DO—Lubricate completely to force out lubricants contaminated by sand or dust. (See LO 9-2350-300-10.)

5 DO—Keep engine and engine compartment clean.



6 DO—Remove all but a thin film of oil from breech mechanism before operating cannon.

7 DO—Clean air filters (page 3-92).

8 DO—Clean radiator fins.

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DOs AND DON'Ts IN DUSTY OR SANDY AREAS – CONTINUED

DOs – CONTINUED

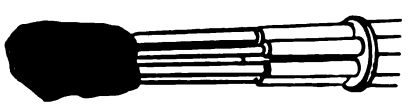
9 DO—Protect periscopes from etching by sand, install covers.

10 DO—Cover grilles and exposed vents when not in use.

11 DO—Protect sight and telescopes from sand.

12 DO—Cover radar antenna when not in use.

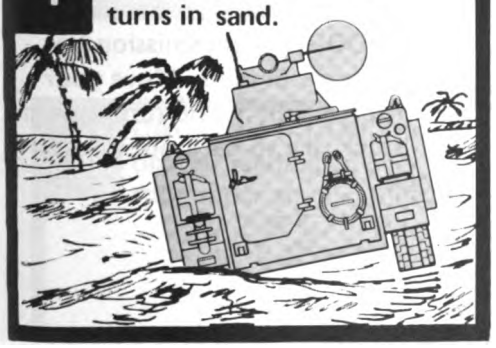
13 DO—Use muzzle cover when cannon is not in use.



14 DO—Provide wind shield and keep area around APU free of dust and sand. Wet area down if possible. Refer to TM 5-6115-323-15.

DON'Ts

1 DON'T—Attempt short turns in sand.



2 DON'T—Over lubricate.

3 DON'T—Spin tracks in sand.

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DOs AND DON'Ts IN DUSTY OR SANDY AREAS – CONTINUED

DON'Ts – CONTINUED

4 DON'T—Lug the engine down.

5 DON'T—Drive through soft, sandy or dusty areas if you can take a hard, solid route.

6 CAUTION – DON'T let tachometer reading go over 2975 rpm under any circumstances.

OPERATING VEHICLE UNDER RAINY OR HUMID CONDITIONS

2-34. General. Unless precautions are taken, dampness will corrode and damage equipment. This action is accelerated during rainy seasons or in humid climates. Electronic and electrical equipment can be severly affected. Driving conditions can become dangerous.

DOs AND DON'Ts UNDER RAINY OR HUMID CONDITIONS

DOs

1 DO your Before Operation PMCS

2 DO—Use transmission low range in mud. Move your vehicle steadily without digging in. If stuck, try to back out or get towed.

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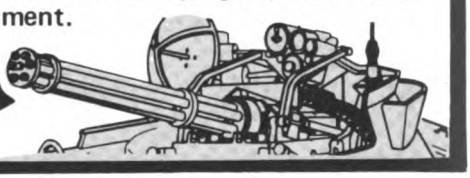
OPERATING VEHICLE UNDER RAINY OR HUMID CONDITIONS – CONTINUED

DOs – CONTINUED

3 DO—Clean mud from all parts as soon as possible. Refer to LO 9-2350-300-10 for lubricating suspension components.

4 DO—Coat cannon barrel cluster and muzzle clamp with thin coat of general purpose oil. See Lube Order.

5 DO—Keep equipment dry. Install system covers (and tarps if available) during rain. Lift, or open covers as soon as possible to allow ventilation. Check with organizational maintenance for methods of drying exposed equipment.

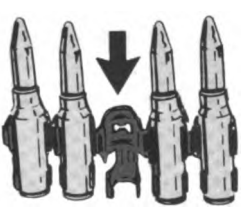


6 DO—Remove corrosion from metal surfaces with abrasive paper or cloth. Apply oil or rust preventative.

7 DO—Keep fuel tanks full to prevent condensation.

8 DO—Keep insects out of vehicle. They can cause shorts with bodies and damp webs.

9 DO—Coat conveyor elements per Lube Order.



10 DO—Erect a shelter to protect the APU. If no shelter, cover with canvas. Remove cover during dry periods.

DON'Ts

1 CAUTION – DON'T let tachometer reading go over 2975 rpm under any circumstances.

2 DON'T—Make sharp turns in mud.

3 DON'T—Fold wet canvas. Dry out if possible.

END

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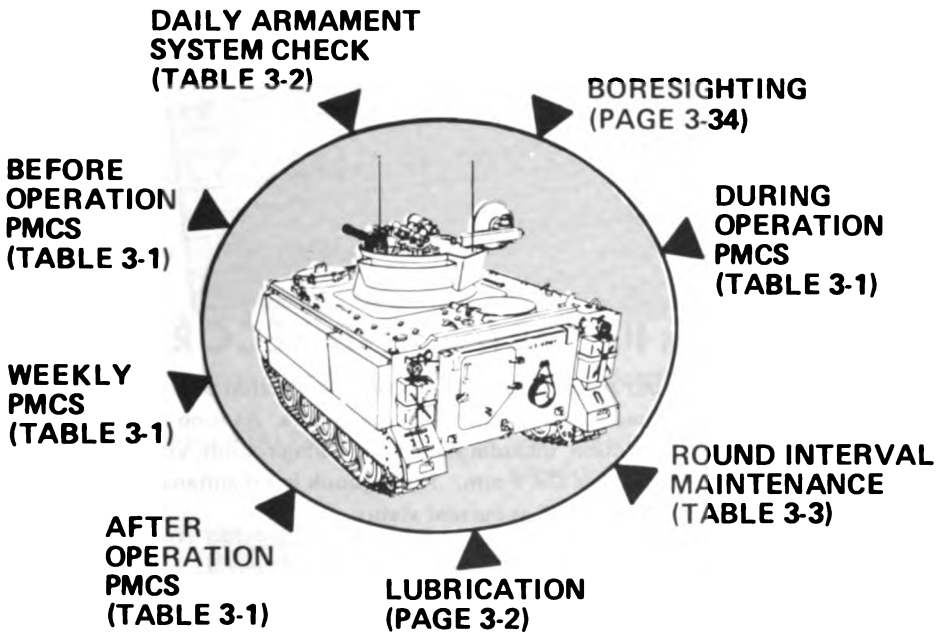
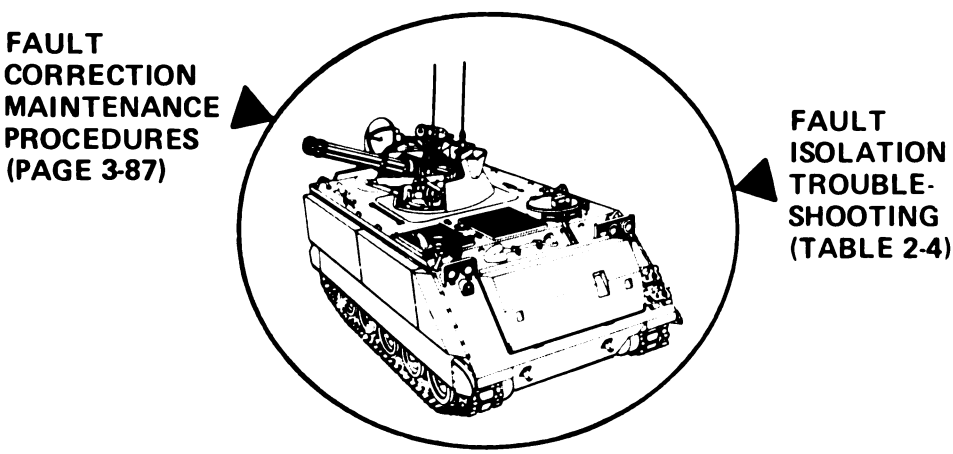
CHAPTER 3
MAINTENANCE INSTRUCTIONS

3-1. Introduction. This chapter contains preventive and corrective maintenance procedures that are required to keep your system serviceable and ready for action. The instructions that follow are the responsibility of the crew.

3-2. The first illustration that follows shows preventive maintenance described in this chapter. The second illustrations shows corrective maintenance.



SYSTEMATIC PREVENTIVE MAINTENANCE



CORRECTIVE MAINTENANCE

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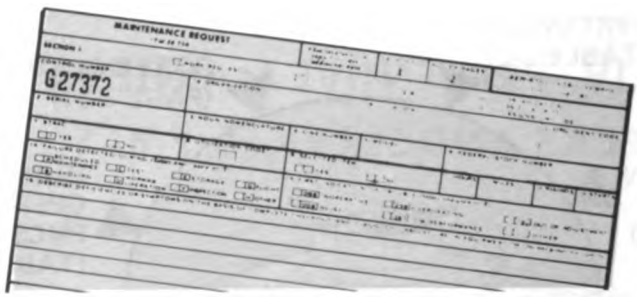
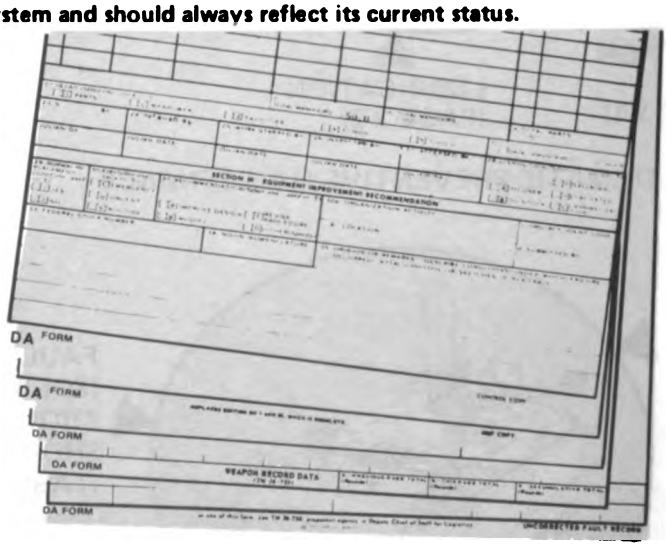
Section I. TOOLS AND EQUIPMENT

3-3. Tools and equipment issued for use by the crew to maintain the system are listed and illustrated in Appendix B. Use only the tools that are provided and make sure they fit properly. Do not use tools or equipment for purposes other than those prescribed. When not in use, make sure tools and equipment are stored properly. Storage locations are given in Appendix D.



Section II. FORMS AND RECORDS

3-4. System Logbook. Your system logbook contains a collection of DA Forms that are described in TM 38-750. These forms must be kept up-to-date. As soon as possible after completing any maintenance action, including firing or cycling rounds, you must make an appropriate entry on the applicable DA Form. The logbook is a maintenance record of your system and should always reflect its current status.



Section III. LUBRICATION

3-5. Lubrication and Service Intervals. Consult LO 9-2350-300-10. This tells you when to lube, what to lube, and what kind of lube to use. Requisitioning information regarding lubricants can be found in Appendix C.

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3-6. Lubrication During Unusual Conditions. Lubricants can quickly lose their protective qualities when exposed to extremely high or low temperatures, dust, sand, or moisture. Prolonged high-rate operation can also break down lubricants. Lubricate more often to compensate for these unusual conditions. Lubrication intervals may be extended during inactive periods.

Section IV. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

3-7. At the specified interval, perform the applicable PMCS as listed in table 3-1.

a.	Before operation (B) PMCS	–	Insures system ready for operation.
b.	During operation (D) PMCS	–	Detects unsatisfactory performance.
c.	After operation (A) PMCS	–	Reveals any damage or unsatisfactory condition resulting from operation.
d.	Weekly (W) PMCS	–	Preventive maintenance actions performed every week.

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GENERAL PROCEDURES

The following general procedures apply to crew preventive maintenance services and to all inspections, and are just as important as specific procedures.

3-8. Inspection. Inspection to see if items are in good condition, correctly assembled or stored, secure, not excessively worn, not leaking, and adequately lubricated applies to most items in the preventive maintenance checks and services. Any or all of these checks that are pertinent to any item (including supporting, attaching, or connecting members) will be performed automatically as general procedures in addition to any specific procedures given.

IMPORTANT: Before using dummy rounds, always clean and inspect for damage. Also check the ammo links. Burred and dirty dummy rounds can cause excessive wear and damage.

1. Inspection for good condition.
   —Visual inspection for damage beyond safe or serviceable limits.

2. Inspection for correct assembly and stowage.
   —Visual inspection for improperly assembled or stowed items.

3. Inspection for security.
   —Visual inspection or check by hand, wrench, or prybar for looseness.

4. Inspection for wear.
   —Visual inspection or check by hand for items worn beyond serviceable limits. Also, applicable to markings, data, caution plates, and printed matter that is illegible.

NOTE: — Where the instruction "tighten" appears in the procedure, it means tighten with the proper tool, even if the item appears to be secure.

3-9. Cleaning. Any special cleaning instructions required for specific components or parts are contained in the pertinent section. General cleaning instructions are as follows:

WARNING

Dry cleaning solvent or mineral spirits paint thinner is flammable and should not be used near an open flame. Fire extinguishers should be provided nearby when these materials are used. Use only in well ventilated places. The use of diesel fuel oil, gasoline, or benzine (benzol) is prohibited for cleaning purposes.

1. Use dry cleaning solvent or mineral spirits paint thinner to clean all unpainted metal parts.

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GENERAL PROCEDURES – CONTINUED

2. IMPORTANT – Don't clean interior of hull with steam, water or air under pressure.

3. IMPORTANT – Before washing vehicle, start engine or cover engine exhaust outlet to prevent water from entering. Also, cover personnel heater exhaust outlet.

4. A solution of one part grease cleaning compound to four parts of dry cleaning solvent or mineral spirits paint thinner may be used for dissolving grease and oil from engine castings, components and engine compartment. After cleaning, use cold water to rinse off solution. See paragraph 3-10, step 2.

5. After parts are cleaned, rinse and dry thoroughly. Apply light grade of oil to all unprotected metal surfaces (other than optical instruments) to prevent rusting.

6. When authorized to install new parts, remove any preservative materials such as rust-preventive compound, grease, etc.. If parts require lubrication, lubricate per LO 9-2350-300-10.

7. To prevent formation of mildew, shake out and air fabric covers for several hours at frequent intervals. Make immediate repairs of minor damage. Mildewed fabric is best cleaned by scrubbing with a dry brush. If water is necessary to remove dirt, it must not be used until all mildew has been removed. If fabric shows no indication of rotting or weakening, it can be re-treated.

8. If metal name plates, caution plates, and instruction plates are corroded, clean thoroughly and coat with preservative oil.

3-10. Cleaning precautions.

1. Dry cleaning solvents and mineral spirits paint thinners evaporate quickly and have a drying effect on skin. If these cleaners are used frequently without gloves, cracks in the skin and a mild irritation or inflammation of the skin may result.

2. Don't get dry cleaning solvent, paint thinner, or engine fuels and lubricants on rubber parts because they will deteriorate rubber that is not resistant to petroleum.

3-11. Specific procedures. Specific preventive maintenance to be performed on the system is listed in tables 3-1 and 3-3. When performing these services, you must record the item number and the malfunction, which is beyond your scope to repair, in accordance with requirements of TM 38-750.

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Table 3-1. Preventive Maintenance Checks and Services

1 hr. 10 min.	2 min.	1 hr. 25 min.	13 min.
B – BEFORE OPERATION	D – DURING OPERATION	A – AFTER OPERATION	W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				M163 SYSTEM
1				System Log Book. Determine status of system.
2				Be Alert during your PM checks for unusual noises or odors from engine, transmission, or suspension that might indicate something is wrong. Watch for signs of lube, fuel, and coolant leaks.
				SUSPENSION SYSTEM
3		51		Road Wheels, Idler Wheels, and Sprockets.
				Inspect for excessive wear or damage. If vehicle leans to one side, check for broken torsion bars by prying up road wheels. Check road wheel and idler wheel hub oil levels (1). Oil should be half way up in sight indicator. Bubbles in oil mean contamination – you must replace the oil. See LO 9-2350-300-10. Check tires for gouges, chips, cuts, and separation from disk. Check idler arm for cracks.
		52		Track shoes. Check bushings and grousers for excessive wear. (page 3-91)
4		53		Shock Absorbers. Check for oil leaks and loose bushings.
				HULL
		54		Access Covers and Drain Plugs. Check under hull for signs of leaks. Check that access covers and drain plugs are secure.

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

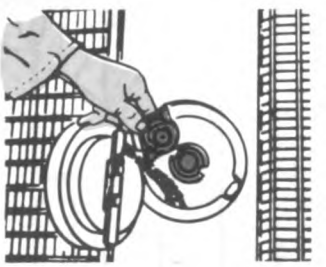
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
		55		Towing Pintle. Check pintle and latch for proper operation or damage. Lube through grease fittings (2) if necessary. See Lube Order.
5		56		External Fire Extinguisher Handle. Check that lead wire seal is not broken.
		57		Trim Vane and Floation Pods. Operate trim vane and check for debris damage. Check pods for deformation damage. Also check pods for structural damage in or near the pod mounting flange area. Notify organizational maintenance of any damage.
				ENGINE COMPARTMENT
6		58		Leaks. Check for fuel, lube, and coolant leaks. 
7		59		Engine Coolant Level. Coolant level must be within 3 inches of top of filler tube. Check strength of antifreeze coolant, if used.

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

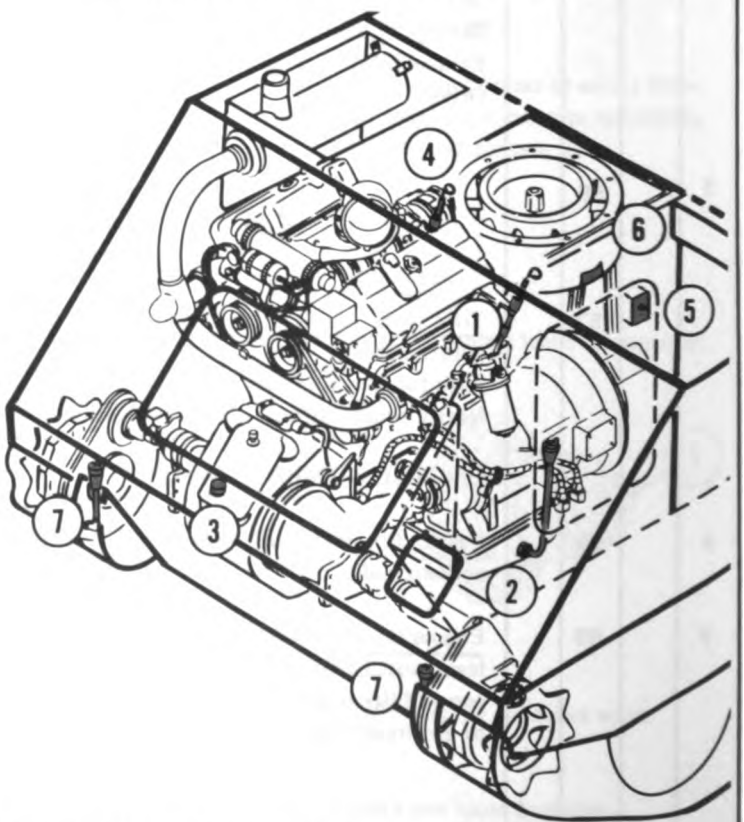
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				PRELIMINARY OIL LEVEL CHECKS.
				
				With the vehicle approximately level, check the following to assure sufficient oil for operation during engine warmup period. Use illustration above for location key.
8		60		Engine Oil Level. Check level on gauge rod.

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

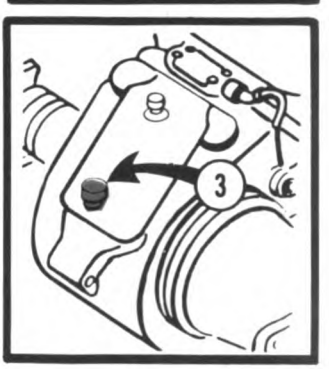
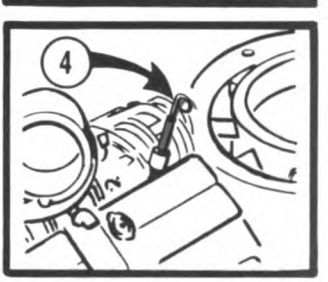
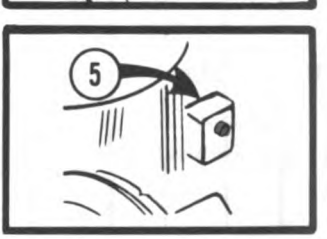
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				Preliminary Oil Level Checks (Continued)
9		61		Transmission Oil Level. Check level on gauge rod.
10		62		Differential Oil Level. Check level on gauge rod. 
11		63		Transfer Gearcase Oil Level. Check level on gauge rod. 
12		64		Hydraulic Tank Oil. Check level on sight indicator. 

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION • D – DURING OPERATION A – AFTER OPERATION W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				Preliminary Oil Level Checks (Continued)
13		65		Fan Gearbox Oil Level. Check level on sight indicator.
14		66		Final Drives (2) Oil Level. Check level on gauge rods.
15		67		Engine Disconnect Control Handle. Handle must be in engaged position – pulled out. May have to jog starter button to engage.

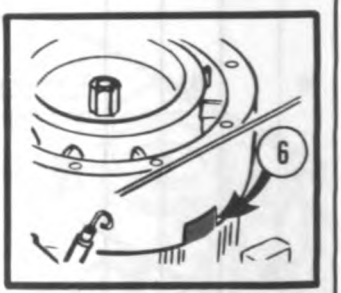

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

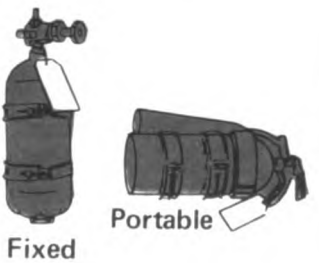
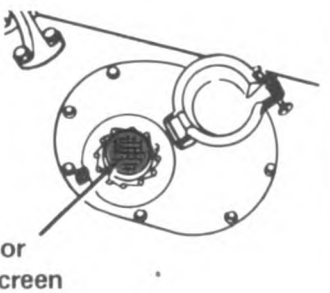
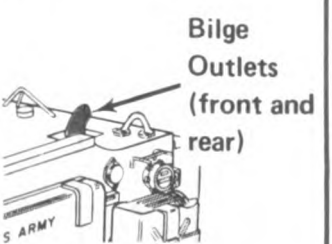
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
16		68		Instrument Panels. Check for cracks, broken or missing meters, indicator glass faces, lamp covers; and other damage. Check installed and stowed periscopes for cleanliness, general condition, and completeness.
17		69		Fire Extinguishers. Check fixed and portable extinguishers for broken seals and serviceable condition. Check inspection tags for current inspection date. 
18		70		Fuel Compartment. Check filler screen for cleanliness. Fill fuel compartment to within 3 inches from top. Turn on MASTER SWITCH and check fuel gage for proper operation. 
19		71		Bilge Pumps. Set BILGE PUMPS switch to ON. If bilges are dry, air will be felt at outlet. Pump bilges dry if necessary (page 2-61). 
20		72		Lights. Check operation of vehicle lights. Check for broken or discolored lenses. Turn on infrared lights and place hand on lens. Heat will be felt if light is operating.

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				CHECKS REQUIRING A WARM ENGINE
				Start engine according to page 2-42, 2-45 or 2-145 and allow engine to warm up for 3 to 5 minutes to 160° – 180°F.
21				Oil Level Adjustment. If any of the following levels are low, add as necessary. Refer to lube order LO 9-2350-300-10 for the correct lubricants. Levels should be checked and adjusted at normal operating temperatures.
				(1) Engine. Stop engine. Allow 2 to 3 minutes for oil to drain down into sump, then check level. It should be between the L and F dots on gauge rod (page 3-8).
				(2) Transmission. Lock brakes, place shift lever in 2-3 range and operate engine at 800 rpm for 3-5 minutes. Move shift lever through all the ranges to assure complete circulation, then return to neutral. Check oil level with engine operating at 1500 rpm. Level must be between FULL and ADD on gauge rod (page 3-9).
				(3) Differential. Idle the engine. Check oil level. It must be between FULL and ADD on gauge rod (page 3-9).
				(4) Hydraulic Oil Tank. Lower ramp and retract suspension lockout cylinders. Fluid must be between MAX and MIN on sight indicator (page 3-9).
				(5) Transfer Gearcase. Oil level must be between FULL and ADD on gauge rod (page 3-9).
				(6) Final Drives (2). Oil level must be between FULL and ADD on gauge rod (page 3-10).
				(7) Fan Gear Box. With engine shut down, oil level must be between FULL and ADD on sight indicator (page 3-10).

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

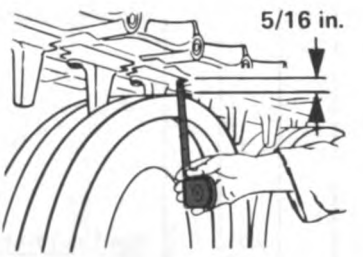
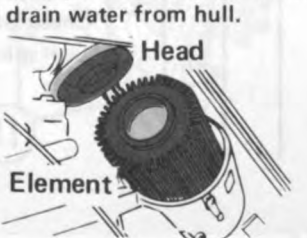
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				CHECKS WITH ENGINE RUNNING
22	50			Steering, Braking, Accelerator, and Shifting Controls. Start engine in accordance with pages 2-42, 2-45, or 2-145. Check steering and braking action, shifting and accelerator controls for binding, grabbing, or excessive play in linkage. Continuously check instrument warning lights while engine is running.
23		73		Suspension Lockout System. Operate engine at 1500 rpm. Place extension lockout control to EXTEND. SUSP LOCKED OUT warning light goes on when cylinders are extended. Check to make sure all cylinders are extended to lock out the road wheels. Check for leaks. Place suspension lockout control to RETRACT. SUSP LOCKED OUT light will go out. Check that all cylinders are fully retracted.
24		74		Track Tension. (Both Tracks) With transmission in 2-3 range, accelerate to approximately 8 mph on firm level ground. Shift to neutral and coast to stop without applying brakes. Distance between top of second road wheel and bottom of track should be 5/16 inch or more (with track resting on third wheel). If not, adjust track tension (page 3-88). 
				CLEANING
		75		Miscellaneous. Remove dirt, mud, and excess grease from exterior. Wipe oil and grease drippings from engine and personnel compartments. Remove hull drain plugs (page 2-59) and drain water from hull.
		76		Engine Air Cleaner. Clean and inspect air cleaner element (page 3-92). 

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

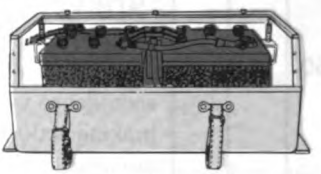
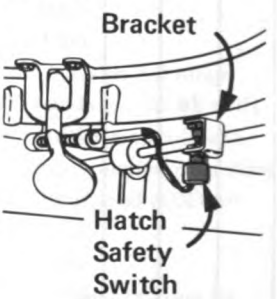
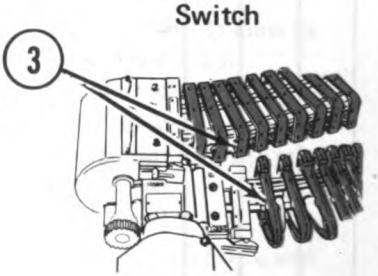
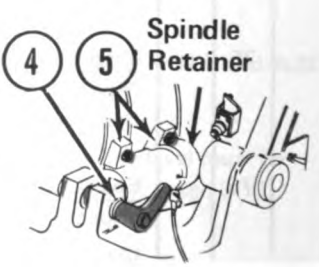
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
		77		Chassis Batteries. Inspect and service (page 3-93). 
				ARMAMENT
		78		Muzzle and Turret Covers. Check that covers are free of tears, frays, dirt, and grease.
25		79		Mount. Check that nothing will interfere with movement of mount and cannon. Clean and inspect mount components.
26		80		Hatch Safety Switches (2). Check that switches are securely mounted and that nothing interferes with switch plungers. 
27		81		Feed and Return Chutes. Check that chutes (3) are secured to feeder and that chuting is not damaged. 
28		82		Recoil Adapters. Check that quick-release pins (4) and mounting bolts (5) are installed. Check that safety wire securing each spindle retainer is unbroken. 

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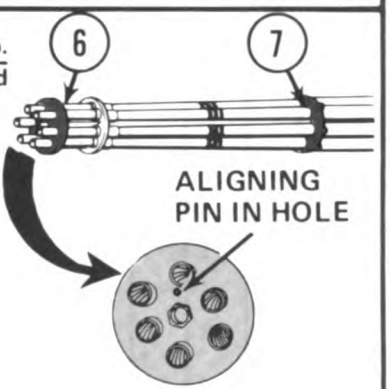
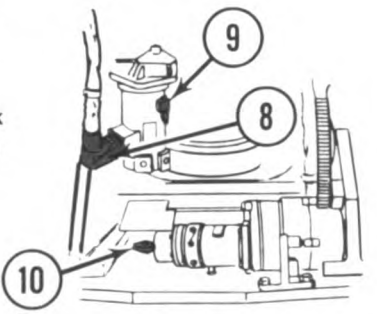
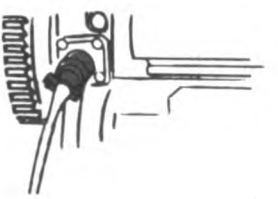
Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
29		83		Muzzle Clamp and Centering Clamp. Check that muzzle clamp is installed correctly with triangular locking plate (6) properly positioned. Check that centering clamp is properly positioned with cotter pin (7) installed.
30		84		Barrels. Check barrels for cracks and bulges.
31		85		Gun Drive Motor and Elevation Drive Motor. Check that gun drive motor connector (8) is installed and safety wired. Check that both gun drive motor brake levers (9) and elevation drive motor brake (10) are in the on position.
32		86		Feeder Solenoid. Check that connector is securely installed.
33		87		Gun Shield. Check that rear support pins engage shield and that latches are down. Check that two quick-release pins (11) are installed.







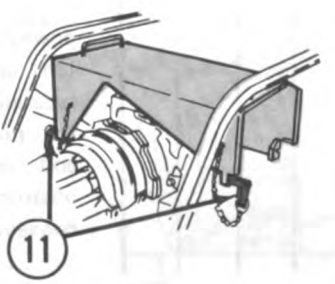


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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

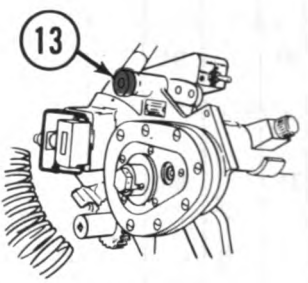
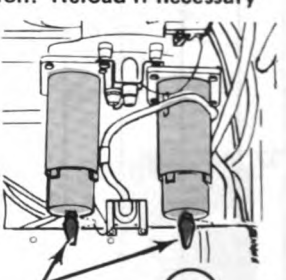
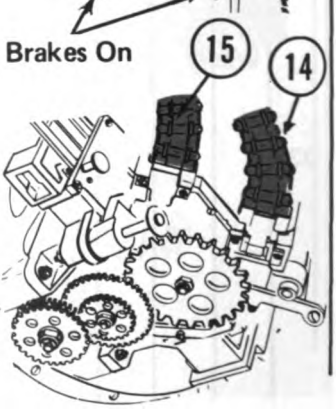
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
34		88		Conveyor Unit. Check that conveyor is in fire position and that handle (12) is down and locked.
35		89		Shift Pin Handle. Check that handle (13) is set to F (fire) position. 
36				Ammunition. Check ROUNDS REMAINING TO FIRE windows in storage drum for sufficient ammunition. Reload if necessary (page 2-77).
37		90		Azimuth Drive Motors. Check that brake release levers on both drive motors are in on position. 
38		91		Feed and Return Chutes Below Deck. Rotate mount to load position. Check that feed chute (14) and return chute (15) are secured to conveyor unit. Check that nothing protrudes into feed and return chutes that will obstruct free flow of ammo and conveyor elements. 

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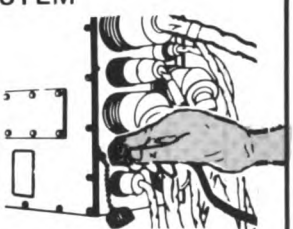
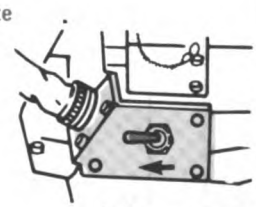
Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
		92	108	Conveyor Elements. Check for corrosion, cracking, or chipping of elements. See Lube Order.
39				Feed System Slack Point. With cannon at approximately 0 degree elevation, check that slack point is positioned properly and that each visible conveyor element contains a round (page 2-85).
40		93		Electrical Cables and Connectors. Check that all cable connectors are connected and secure. Check cables for kinks, cuts, or abraded insulation.
				CANNON, FEEDER, AND FEED SYSTEM
41				Perform the following steps (1 through 6) before operation:
				(1) Arming Connector. Remove from distribution box (J6).
				WARNING Do not use live ammunition in the next step. Do not use burred, damaged, or dirty dummy rounds.
				CAUTION Do not hold BRAKE-CLEAR AND BRAKE switch in CLEAR AND BRAKE position longer than 10 seconds during any 1 minute interval.
				(2) BRAKE-CLEAR and BRAKE switch. Hold to BRAKE, rotate cannon by hand and cycle 6 to 12 dummy rounds through cannon.
				(3) BRAKE-CLEAR and BRAKE switch. Hold to CLEAR AND BRAKE and rotate cannon by hand until cannon is cleared.





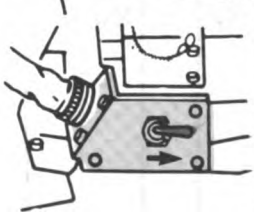


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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

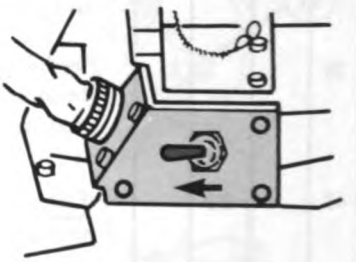
INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				(4) BRAKE-CLEAR and BRAKE switch. Hold to BRAKE and rotate cannon by hand until feeder is engaged. 
				(5) Dummy Rounds. Remove cleared dummy rounds from case chute.
				(6) Arming Connector. Install in distribution box (J6).
42		94		M61 Sight. Clean and inspect (page 3-108).
43		95		M134 Straight Telescope. Clean and inspect (page 3-5).
44		96		AN/TVS-2B Night Sight. Clean and inspect (TM 11-5855-202-13).
45		97		Control Panel Illuminating, Azimuth Indicator Lights, and Gunners Shield Light. Check for operation.
46		98		Dome Lights. Check for operation (page 2-7).
		99		M168 Cannon. Clean and inspect (page 3-97).
				RADAR
47		100		Interconnecting Cables. Check all cables for excessive wear, damage, or kinks. Check interconnecting waveguide for cracks and proper fastening at flanges. Check that RF power indicator is clean.

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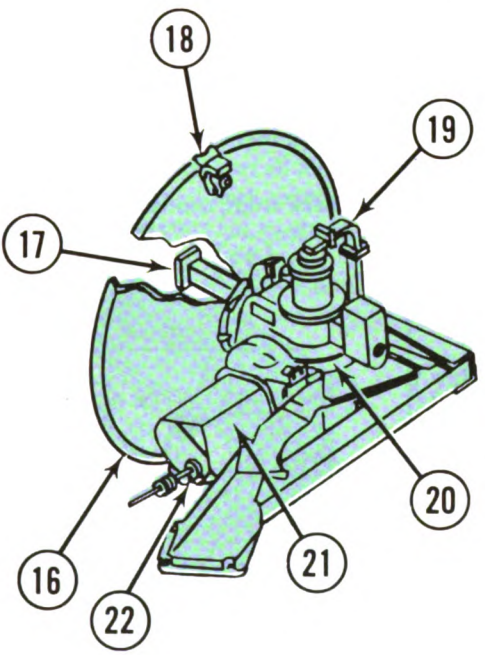
Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				RADAR (CONTINUED)
		101		Antenna.



a. Check reflector (16) for dents, holes, or other damage.

b. Check feed assembly (17) for cracks, loose hardware, and missing windows. Check alignment of feedhorn (page 3-115).

c. Check boresight telescope bracket and clamps (18) for loose hardware.

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Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				d. Check waveguide (19) for cracks and proper fastening at flanges.
				e. Check that covers on traverse servo drive (20) and elevation servo drive (21) are secure.
				f. Check that elevation input couplings (22) are not loose.
				g. Check stops, connectors, and bumpers for looseness or damage.
			109	Receiver-Transmitter.
				a. Check inside for broken leads and components.
				b. Check that tuning tool (23) is snug-tight in bracket.
				c. Check that spare crystals (24) are secured properly.

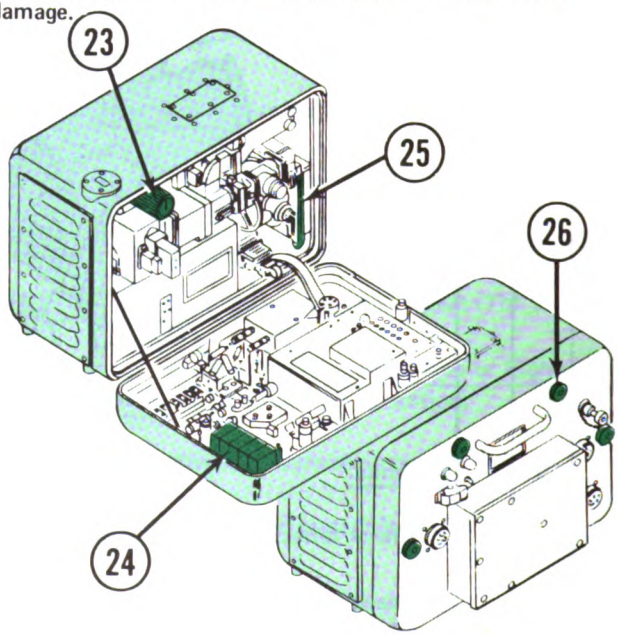

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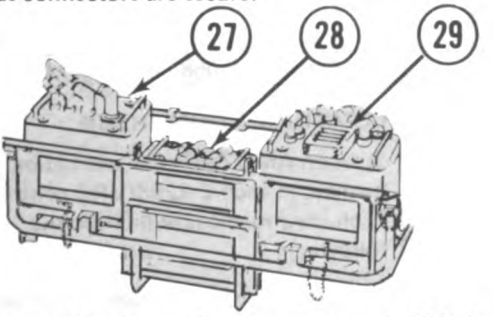
Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				d. IMPORTANT - Check that ventilators are unobstructed and allow free flow of air. Otherwise failure due to overheating will occur.
				e. Clean air filter (25), (page 3-113).
				NOTE Clean air filter daily when operating in dusty or sandy areas.
		102		Receiver-Transmitter. Check that all thumbscrews (26) are snug-tight when front panel is closed. Check exterior for damage and broken parts. Check that connectors are secure.
		103		Receiver and Range Computer. Check exterior of receiver (27) and computer (28) for damage. Make sure all thumbscrews are snug-tight Check that connectors are secure.
		104		Power Supply. Check exterior of power supply (29) for damage. Make sure all thumbscrews are snug-tight. IMPORTANT - make sure that air intake and exhaust ports are unobstructed and allow free flow of air. Otherwise failure due to overheating will occur. Check that connectors are secure.
			110	Power Supply Air Filter. Clean air filter (page 3-114). NOTE Clean air filter daily when operating in dusty or sandy areas.
		105		Stow Control. Check exterior for damage and deterioration of switch boots. Check that connectors are secure.



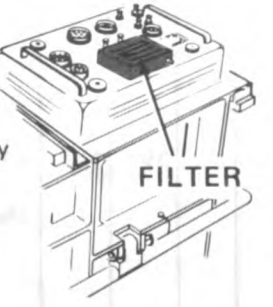


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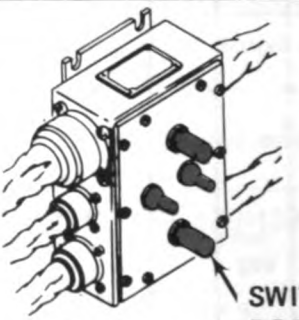
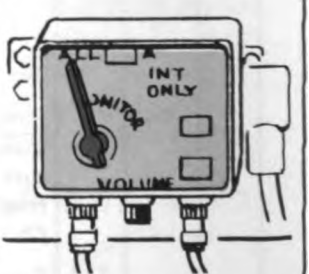
Table 3-1. Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
		106		Gun System Batteries. Check exterior of battery cases for corrosion and damage. Check that connectors are secure.
			111	Slip Ring. Check that slip ring mounting bolts and drive bolts are secure. Check that cable connectors are secure and not damaged.
47				BORESIGHT NOTE In those instances when a system has not been relocated and the radar set and M61 sight are not being readied for operation, boresighting should be done once a month. M168 Cannon, M61 Sight, M134 Telescope, AN/TVS-2B Night Sight and Radar Antenna. Boresight these units (page 3-34 or 3-43).
48				COMMUNICATION CHECK Turn on AM-1780/VRC and radios. Connect CVC helmets to each C-2298/VRC control box. Each crew member will check the following: a. Intercommunication operation is satisfactory. b. Radio transmission operation is satisfactory. Reference TM 11-5820-401-12.
49				DAILY ARMAMENT SYSTEM CHECK Perform the Daily System Armament Check (page 3-23). This will complete the Daily PMCS.
		107	112	SYSTEM LOG BOOK Make the entries in the log book that are required by TM 38-750.





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Section V. DAILY ARMAMENT SYSTEM CHECK

3-12. Perform this daily armament system check (table 3-2) every day after completion of your Before Operation PMCS. While performing the check, watch for any indication that appears abnormal – whether listed or not. Notify organizational maintenance of any abnormal or faulty condition that is beyond the repair capability of crew maintenance.

3-13. Table 3-2 includes all the checks necessary to prove the system operational. Set up the Precheck Conditions of step 1 then perform the checks in sequence as listed.

Table 3-2. Daily Armament System Check

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. PRECHECK CONDITIONS		
Arming connector	removed	
Sight caging knob	CAGED	
SYSTEM POWER	OFF	
GUN POWER	OFF	
RANGE in meters	500	
TARGET SPEED in knots	300	
GUN CLEAR	AUTO	
MODE	MAN	
Stow control MODE	NORM	
Stow control MAINT	OFF	
Distribution box circuit breakers (4)	RESET (press in)	
NORM-STATIC-TEST	NORM (up)	
Cannon	unstow	
Azimuth and elevation drive motor brakes	on	
Vehicle engine or APU	operating and adjusted for proper voltage	
Commander's and driver's hatches	closed and latched	
2. SYSTEM POWER CHECK		
(1) Set SYSTEM POWER to ON		
SYSTEM POWER indicator lights		Page 3-73

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Table 3-2. Daily Armament System Check —Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
	Sight reticle lights after approximately 10 seconds.	Perform step (2)
(2) Rotate SIGHT LAMP knob both ways from OFF		
	Reticle intensity increases in both directions.	Page 3-85
(3) Unstow radar antenna (page 2-105).		Page 3-82
3. HATCH PROTECTIVE CIRCUITS		
WARNING Warn all personnel in and around the vehicle that you are going to traverse the cannon. Make sure everyone is clear before you do.		
(1) With cannon at 0 degree elevation, slowly slew the mount one revolution (360°) in both directions.		
	Mount traverses smoothly and without interruption, passing freely over closed hatches.	Pages 3-74, 3-75
(2) Open and latch driver's and commander's hatches. with cannon at 0 degree elevation attempt to traverse over the hatches.		
	The mount stops (from either direction) before gun reaches a hatch.	Notify organizational maintenance
(3) Elevate cannon enough to allow traversing over open hatches.		
	Cannon will not move over open hatch from either direction unless elevated approximately 20 degrees, or more.	Notify organizational maintenance
(4) Elevate cannon approximately 60 degrees over open hatches. In turn hold action switch pressed, and depress cannon.		Pages 3-74, 3-75

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Table 3-2. Daily Armament System Check – Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
	Cannon will not depress below approximately 20 degrees elevation.	Notify organizational maintenance
(5) Close and latch both hatches.		
4. ELEVATION DRIVE MOTOR CUT-OUT CHECK		
(1) Elevate cannon to maximum elevation.		
	Cannon does not hit mechanical stop. Motor stops running 1/4" from stop.	Notify organizational maintenance
(2) Depress cannon to minimum elevation.		
	Cannon does not hit mechanical stop. Motor stops running 1/4" from stop.	Notify organizational maintenance
5. SIGHT TRAVERSE LEAD ANGLE CHECK		
(1) Uncage the M61 sight.		
(2) Verify that cannon is approximately horizontal.		
(3) Traverse to the right and adjust the traverse rate until the 2nd dot (200 mil lead angle dot) stabilizes at the white indicator arrow (lead angle index). When a stable rotation rate is reached, time one complete rotation of the mount.		
	Time for one revolution is between 16 and 20 seconds.	Notify organizational maintenance
(4) Continue to traverse and press the sight cage switch on the left-hand grip.		

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Table 3-2. Daily Armament System Check—Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
	Sight reticle moves towards the center.	Notify organizational maintenance
6. SUPER ELEVATION CHECK FOR MANUAL AND EXTERNAL MODES		
(1) Connect external range control to receptacle in crew compartment or at right rear of chassis.		
(2) Set TARGET SPEED to 0. Position cannon so that the bottom of inner circle of sight reticle is on a fixed target (distant aiming point) about zero degree elevation (0° mark on linkage arm).		
(3) Set the NORM-STATIC-TEST switch to STATIC (center position).		
(4) Set RANGE to approximately 1700 and press the action switch.		
	The top of inner circle repositions on the target.	Notify organizational maintenance
(5) Release the action switch. Set MODE switch to EXT and press action switch.		
	The READY WHEN LIT indicator goes out; the top of the sight inner circle is on the target.	Notify organizational maintenance
(6) Release the action switch and set MODE switch to MAN.		
	The READY WHEN LIT indicator lights.	Notify organizational maintenance

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Table 3-2. Daily Armament System Check—Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
(7) Set RANGE midway between 2000 and 2500; set TARGET SPEED to 600 and press the action switch.		
	Top of sight inner circle remains on the target.	Notify organizational maintenance
(8) Release action switch and set MODE switch to EXT.		
	READY WHEN LIT indicator goes out.	Notify organizational maintenance
(9) Set METERS X100 on external range control to 20.		
	Top of sight inner circle remains on the target.	Notify organizational maintenance
(10) Press and hold the action switch and the pushbutton on the external range control.		
	Sight ready-to-fire indicator lights.	Notify organizational maintenance
(11) Release action switch and pushbutton on external range control.		
	Ready-to-fire indicator goes out.	Notify organizational maintenance
(12) Set MODE switch to MAN. Set the RANGE fully counterclockwise, and set TARGET SPEED to zero.		
(13) Set NORM-STATIC-TEST switch to NORM and position cannon so that bottom of the inner circle of sight reticle is on the target.		

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Table 3-2. Daily Armament System Check – Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
(14) Manually cage the sight.		
	The target is approximately in the center of the inner circle of the sight reticle.	Notify organizational maintenance
(15) Disconnect and stow the external range control.		
7. SIGHT CURRENT GENERATOR CHECK		
(1) Record setting of MUZZLE VELOCITY switch on sight current generator and then set dial to 5.		
(2) Record the setting of the AIR DENSITY switch and then set to 0.85 for M220 ballistics or 1.0 for M246 ballistics.		
(3) Position cannon to approximately 0 degree elevation. Set MODE switch to TEST.		
(4) Press the action switch .		
	GOOD WHEN LIT indicator lights after approximately 2 seconds and stays on as long as pressure is applied to right or left action switch.	If step (4) fails to give proper indication, change setting on AIR DENSITY switch to 1.0 or 0.85 whichever was not used to conduct original check. Repeat test (if this fails notify organizational maintenance).
(5) Release action switch.		
(6) Set MUZZLE VELOCITY and AIR DENSITY switches back to the original settings recorded in steps (1) and (2).		

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Table 3-2. Daily Armament System Check – Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
8. RADAR CHECK		
(1) Check to make sure radar is at desired frequency. If frequency must be changed, refer to page 3-51 for instructions		
(2) Set MODE switch to RADAR and wait two (2) minutes ± 15 seconds for system to warm up.		
(3) Make sure all six circuit breakers on radar power supply are in reset (pressed in) position.		
	READY WHEN LIT light goes on. Radar is in standby.	Notify organizational maintenance
(4) Set receiver-transmitter CLUTTER LOCKON switch to NORMAL.		
(5) Set stow control MODE switch to NORM.		
(6) Set stow control MAINT switch to OFF.		
	Make sure receiver-transmitter HIGH-VOLTAGE POWER SUPPLY OVERLOAD indicator and MODULATOR OVERLOAD indicator are not lit.	Page 3-83
	WARNING Radar emissions are hazardous within three feet of the antenna.	
	CAUTION Do not radiate at targets closer than 250 meters. This will damage the radar receiver (unit 3).	
(7) Depress right or left action switch and reposition cannon in both azimuth and elevation.		

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Table 3-2. Daily Armament System Check – Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
	Antenna repositions to align with the axis of the cannon.	Page 3-82
NOTE: When radiating, the following temporary condition may occur: The headset doppler tone suddenly stops - the READY WHEN LIT light, the sight ready-to-fire light, and the waveguide RF indicator go out. Immediately release the foot switch, cage the sight (if uncaged), and set the MODE switch to GRD. Wait five seconds and reset MODE switch to RADAR, uncage the sight (if required), and continue the check. If condition persists, notify organizational maintenance.		
(8) Hold action switch pressed and depress footswitch.		
	Waveguide RF power indicator lights.	Page 3-82
(9) Release foot switch and action switch.		
(10) Set receiver-transmitter CLUTTER LOCKON switch to TEST. Connect headset or short unbanded lead of CVC helmet to J4 connector on the receiver-transmitter.		
(11) Aim at a point in the sky above a fixed target 250 to 2000 meters distant. Hold action switch pressed and depress footswitch.		
	Ready-to-fire indicator does not light and no tone is heard in headset.	

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Table 3-2. Daily Armament System Check—Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
(12)	Slowly depress cannon until target appears in sight reticle.	
	Ready-to-fire indicator lights and tone is heard in headset indicating clutter lockon has occurred.	
(13)	Slowly elevate cannon towards original position.	
	Tone stops and ready-to-fire indicator goes out when target disappears from sight reticle.	Notify organizational maintenance.
(14)	Set CLUTTER LOCKON switch to NORMAL. Remove headset or helmet connector from J4.	
	NOTE: Two crewmen are required for the following steps.	
	WARNING Make sure all personnel are clear of cannon travel above deck and mount travel below deck before performing the following steps.	
(15)	Manually uncage the sight.	
(16)	Press MID-RANGE CALIBRATION pushbutton on range computer (Unit 4).	
	MID-RANGE CALIBRATION indicator lights brightly within five seconds.	Notify organizational maintenance.
(17)	Release MID-RANGE CALIBRATION PRESS TO TEST pushbutton.	
	Indicator remains lit for two seconds, then resumes blinking.	Notify organizational maintenance.
(18)	Press action switches separately and elevate the cannon very slowly up and down.	
	Cannon elevates, following control movement smoothly	Notify organizational maintenance.

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Table 3-2. Daily Armament System Check – Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
(19) Press MID-RANGE CALIBRATION push-button on range computer (Unit 4) while cannon is elevating.		
a.	Cannon speeds up in direction of travel	Notify organizational maintenance.
b.	Sight reticle and radar antenna move in direction opposite to cannon movement.	
c.	MID-RANGE CALIBRATION indicator lights brightly, then resumes blinking.	
(20) Cage the sight.		
9. GROUND MODE CHECK		
(1) Set MODE switch to GRD.		
	Sight reticle remains illuminated.	Notify organizational maintenance.
(2) Traverse and elevate the cannon.		
	Cannon traverses and elevates normally.	Pages 3-74, 3-75, 3-76

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Table 3-2. Daily Armament System Check – Continued

CHECK	NORMAL INDICATION	IF INDICATION IS ABNORMAL REFER TO
10. BORESIGHTING		
(1) If the cannon requires boresighting at this time, continue with the applicable method (page 3-34 or 3-43). If the cannon does not require boresighting, shut down the system according to the next step.		
(2) Shut down the vehicle, or APU, engine. Install arming connector in the distribution box. Set all the controls to PRESET CONTROL POSITION as shown at beginning of this Daily Armament System Check.		

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BORESIGHTING, DISTANT AIMING POINT METHOD

3-14. Use this method when there is good visibility for at least 2500 meters. If visibility does not extend this far, use the Boresight Target Method on page 3-43.

1. Set GUN POWER switch to OFF.

2. Remove arming connector from distribution box and set NORM-STATIC-TEST switch to NORM.

3. Clear cannon - hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE position and rotate cannon barrels two complete revolutions. Remove any rounds in the case chute.

   NOTE: If you are using a ground role (circular) muzzle clamp, the No. 1 barrel is not marked. In step 4, time the cannon without regard to the No. 1 barrel position.

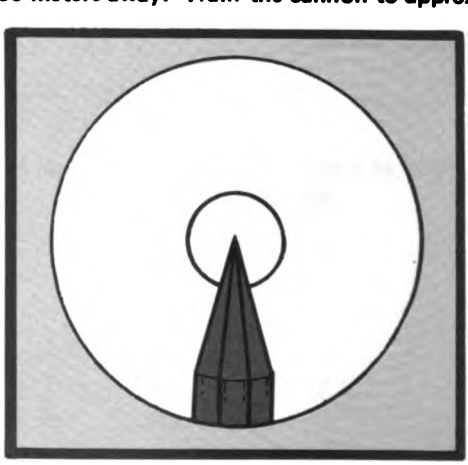
4. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE, depress cannon index pin, and position the No. 1 barrel (marked on eliptical antiaircraft muzzle clamp) in firing position at 4 o'clock as viewed from muzzle end. Release switch and index pin. Check that pin has returned to normal (out) position.

5. Set SYSTEM POWER switch to ON and MODE switch to RADAR.

6. Set stow control MAINT switch to ON and stow control MODE switch to NORMAL.

7. Select a distant aiming point at least 2500 meters away. Train the cannon to approximate position for boresighting.

8. Mechanically uncage sight. Press action switch and position cannon so that distant aiming point is centered in the inner reticle of sight. Release action switch and mechanically cage sight.



9. On the distribution box, set NORM STATIC-TEST switch to STATIC. Set SYSTEM POWER switch to OFF.

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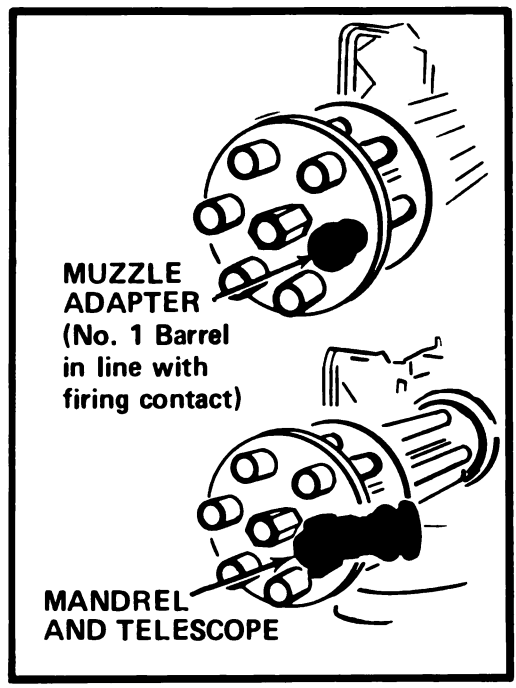
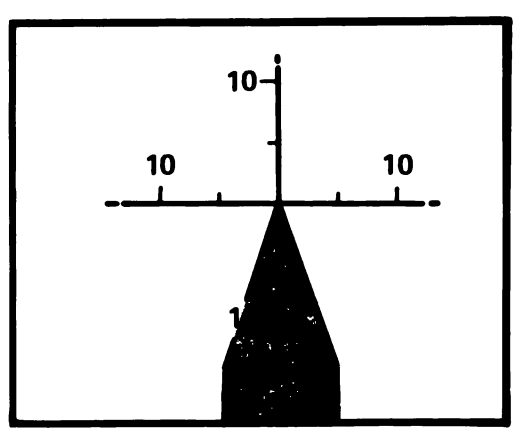
BORESIGHTING, DISTANT AIMING POINT METHOD - CONTINUED

10. Insert muzzle adapter from boresight kit into muzzle of No. 1 barrel (4 o'clock position).



11. Make sure the mandrel and boresight telescope are properly assembled, then insert the assembly into the muzzle adapter with the eyepiece in horizontal position. Press to tighten the assembly in barrel.

12. Release elevation and azimuth drive motor brakes. Hold cannon to left and down. Sight through the telescope and line up a distinctive feature of the distant aiming point in crosshairs.



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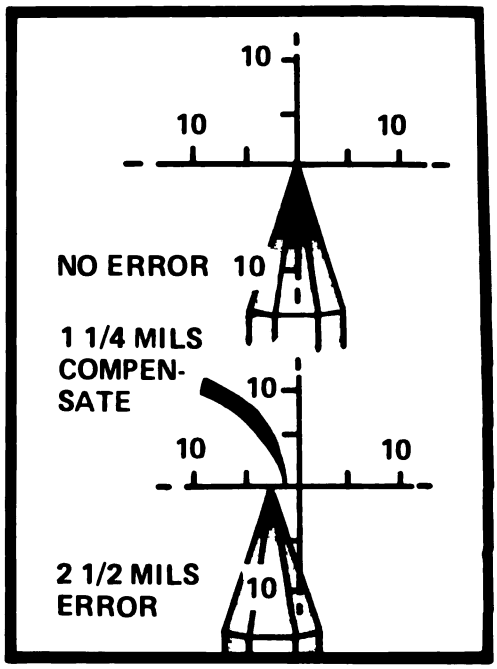
BORESIGHTING, DISTANT AIMING POINT METHOD – CONTINUED

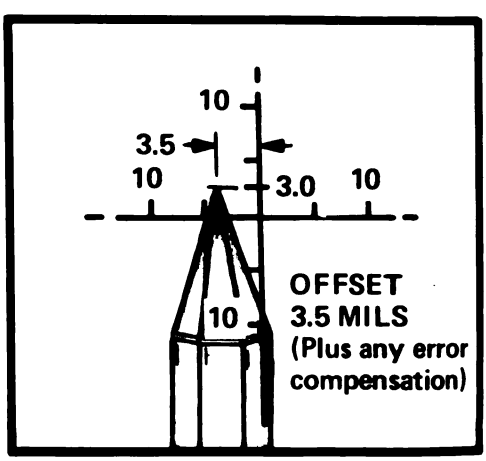
13. Rotate mandrel and telescope assembly 180 degrees to horizontal position on opposite side of barrel. Sight through telescope and determine if point originally sighted on is still at the crosshairs. If crosshairs are displaced over 5 mils from point sighted on, boresight kit is defective. If crosshairs are displaced less than 5 mils, continue to use the kit. Compensate for under 5 mil error by offsetting the crosshairs from aiming point by one-half of the error.



14. Hold gun to left and up. Sight through boresight telescope to determine if crosshairs are displaced less than 5 mils (in either azimuth or elevation) from aiming point. If displaced more than 5 mils, discontinue procedure and call organizational maintenance.

NOTE: Before firing at a fixed boresight target to determine system bias, always hold gun down and to the left.

15. Rotate boresight telescope and mandrel so that eyepiece is in vertical position. Manually position cannon so that crosshairs of the telescope are level with, and approximately 3.5 mils (plus any error compensation) to the right of the aiming point. Lock the elevation and azimuth drive motor brakes and check that the crosshairs haven't moved.



16. Set SYSTEM POWER switch to ON. Manually uncage the sight and adjust the control assembly SIGHT LAMP knob for a clear reticle in the sight.

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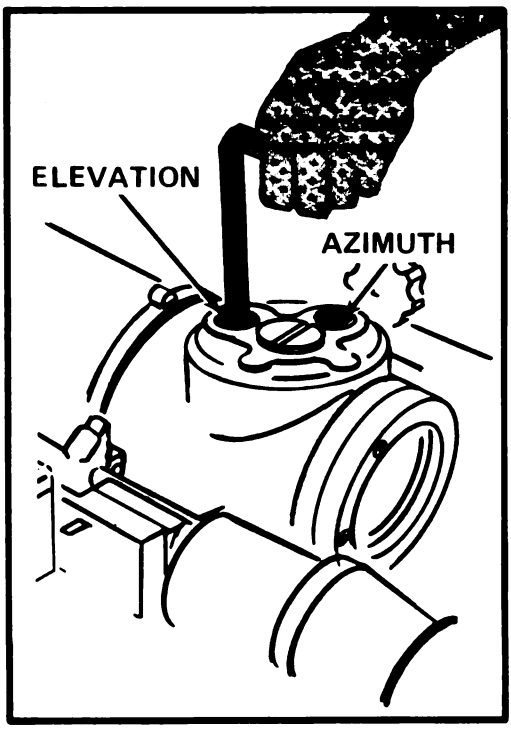
BORESIGHTING, DISTANT AIMING POINT METHOD—CONTINUED

17. Remove screw caps from the elevation and azimuth adjustment access holes on top of the sight. Do not disturb the third cap.

18. Have a second crewman look through the telescope as adjustments are being made to make sure the cannon does not move.

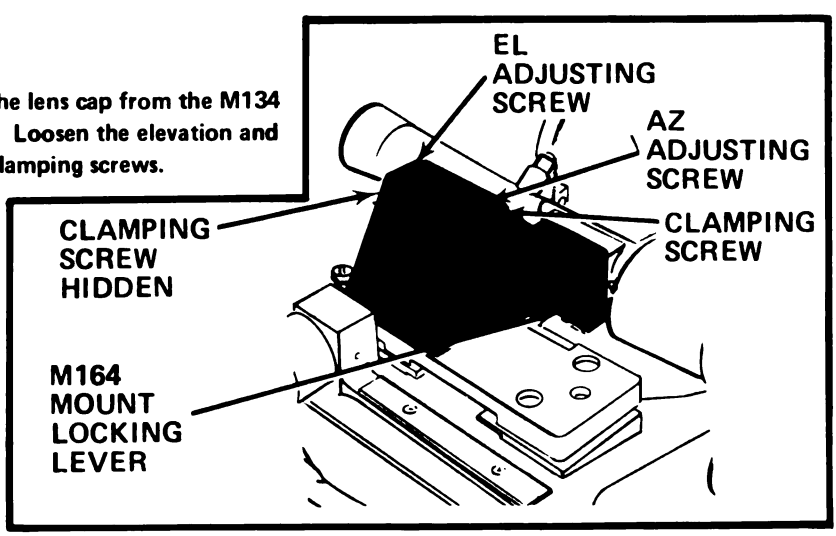
19. As you make the following adjustments, move your eye up and down, and right and left to minimize the apparent shifting of the target. Watch the sight reticle and turn the elevation and azimuth adjustment bolts until the inner sight reticle is centered on the distant aiming point.



20. Install the screw caps on the adjustment access holes.

21. If the M134 straight telescope is to be used, install it on the M164 mount according to page 2-75, and boresight it as follows.

22. Remove the lens cap from the M134 telescope. Loosen the elevation and azimuth clamping screws.



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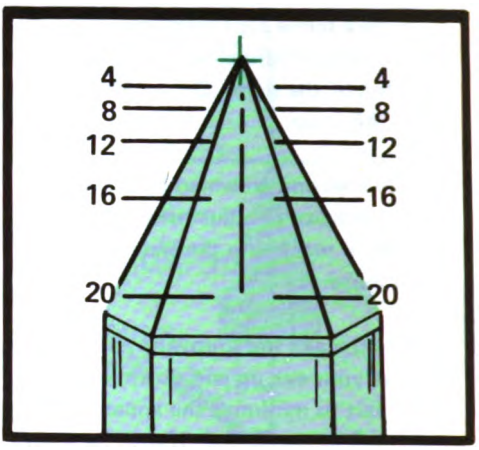
BORESIGHTING, DISTANT AIMING POINT METHOD – CONTINUED

23. Look through the M134 telescope and turn the AZ adjusting screw to bring crosshairs of the reticle into vertical alignment with the distant aiming point.

24. Turn the EL adjusting screw to bring crosshairs of the reticle into horizontal alignment with the distant aiming point.

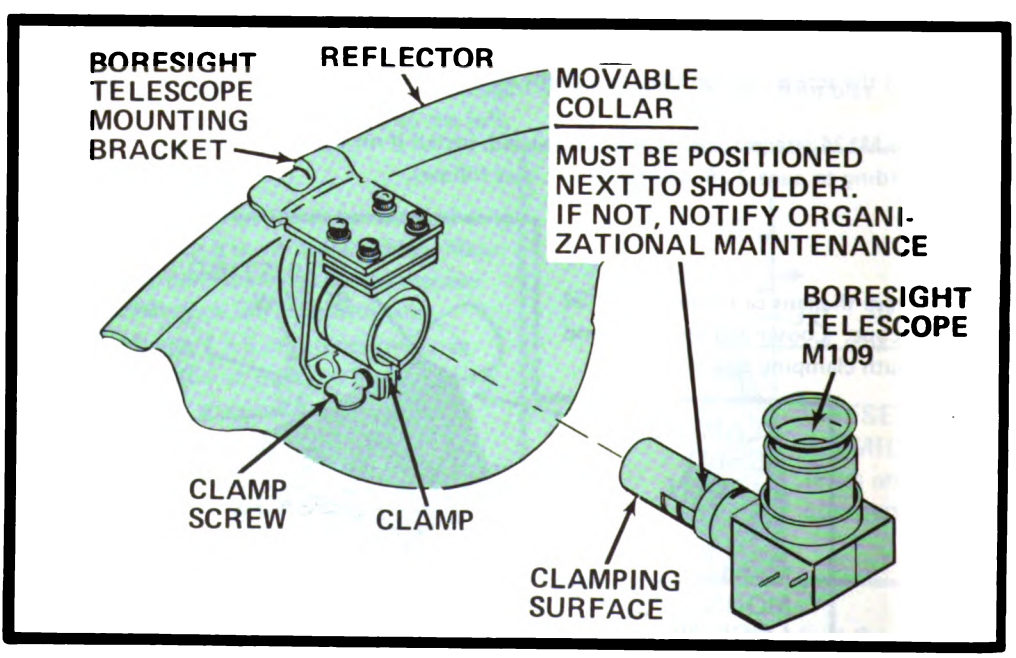
25. Tighten clamping screws and install lens cover.



26. Remove boresight telescope and mandrel assembly from muzzle adepter.

WARNING

Be sure to remove muzzle adapter from cannon barrel.



27. Remove telescope from mandrel and install in the telescope mounting bracket on the antenna.

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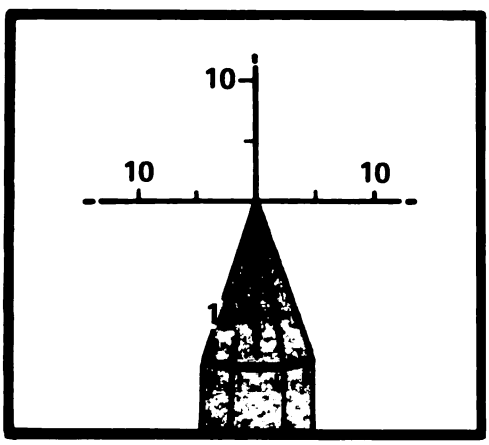
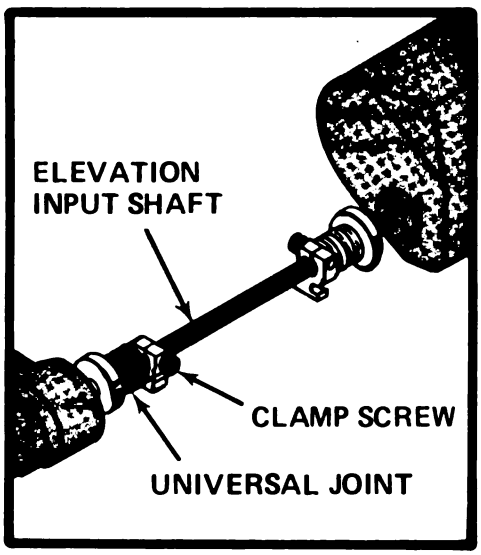
BORESIGHTING, DISTANT AIMING POINT METHOD – CONTINUED

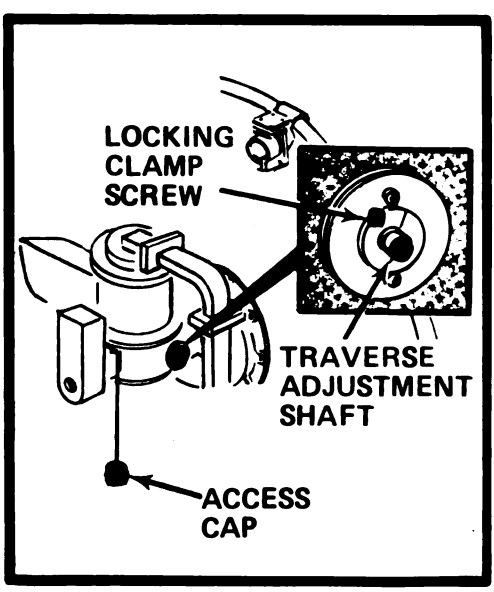
28. Use a second crewman to make sure that the M61 sight reticle is centered on the distant aiming point before, during, and after the next adjustments.

IMPORTANT: Any pressure on antenna or telescope will cause error.

29. Loosen universal joint clamp screw. Rotate the elevation input shaft to move horizontal crosshair of the telescope reticle on the distant aiming point. Tighten the clamp screw.

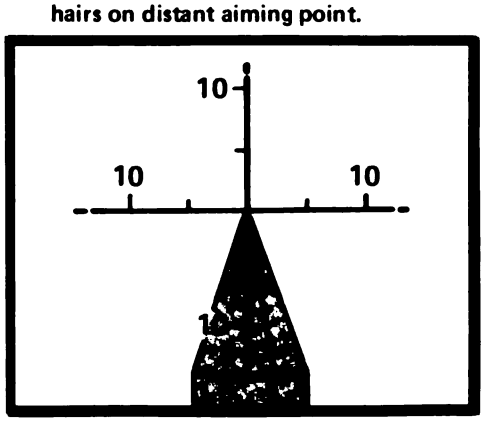






30. Remove cover from traverse boresight adjustment. Loosen clamp screw and turn adjustment shaft until vertical crosshair intersects the distant aiming point. Tighten clamp screw and replace cover.

31. Repeat steps 29 and 30 as necessary to center the boresight telescope crosshairs on distant aiming point.



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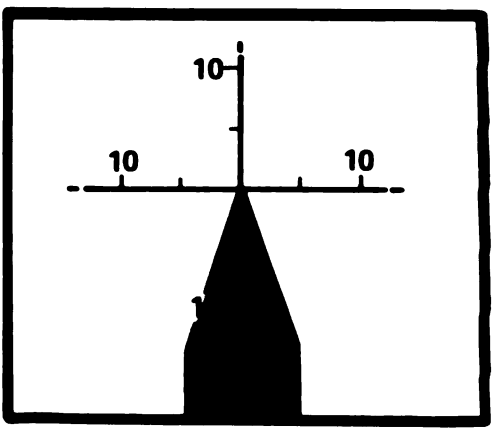
BORESIGHTING, DISTANT AIMING POINT METHOD – CONTINUED

32. Set stow control MODE switch to STOW.

33. Use stow control TRAV switch and drive the antenna approximately 10 degrees to the left. Set stow control MODE switch to NORMAL. Antenna will reposition.

34. Look through the boresight telescope and check if the crosshairs are centered on the distant aiming point.

    NOTE: If antenna does not respond in the following steps, notify organizational maintenance.

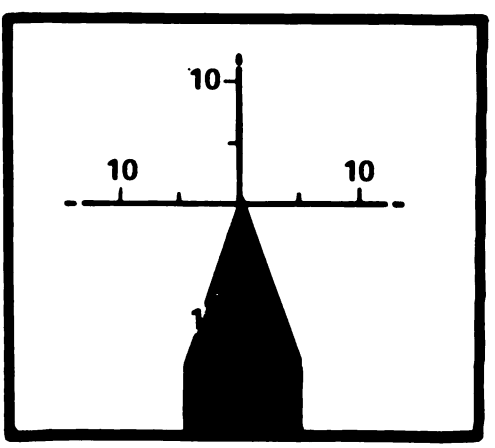


35. Set stow control MODE switch to STOW.

36. Use stow control TRAV switch and drive the antenna approximately 10 degrees to the right. Set stow control MODE switch to NORMAL. Antenna will reposition.

37. Look through the boresight telescope and check if the crosshairs are centered on the distant aiming point.

    NOTE: If antenna does not reposition, call organizational maintenance.



38. Set stow control MODE switch to STOW.

39. Use stow control ELEV switch and drive the antenna up approximately 10 degrees. Set stow control MODE switch to NORMAL. Antenna will reposition.

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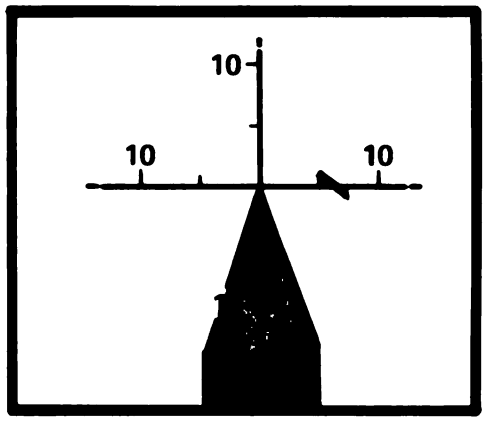
BORESIGHTING, DISTANT AIMING POINT METHOD–CONTINUED

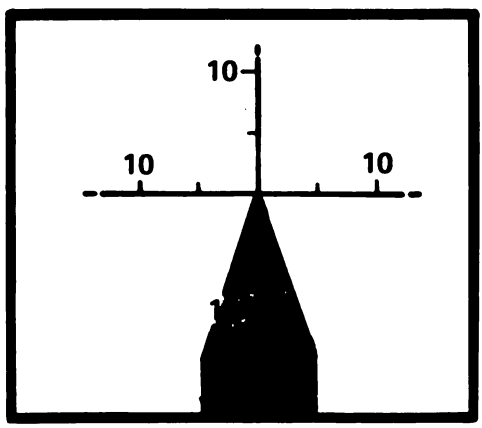
40. Look through the boresight telescope and check if the crosshairs are centered on the distant aiming point.



41. Set stow control MODE switch to STOW.

42. Use stow control ELEV switch and drive the antenna down approximately 10 degrees. Set stow control MODE switch to NORMAL. Antenna will reposition.

43. Look through the boresight telescope and check if the crosshairs are centerad on the distant aiming point.



44. Set stow control MAINT switch to OFF. Remove the boresight telescope from antenna and install cover over bracket.

45. Cage the M61 sight and set SYSTEM POWER switch to OFF.

46. IMPORTANT – recheck that there is nothing in the cannon muzzles.

47. Place NORM-STATIC-TEST switch to NORM and install arming connector.

48. If AN/TVS-2B night sight is to be used, install it according to page 2 140.

CAUTION

Do not remove the night sight lens cover in the daylight.
Never let the sun shine directly into the lens.

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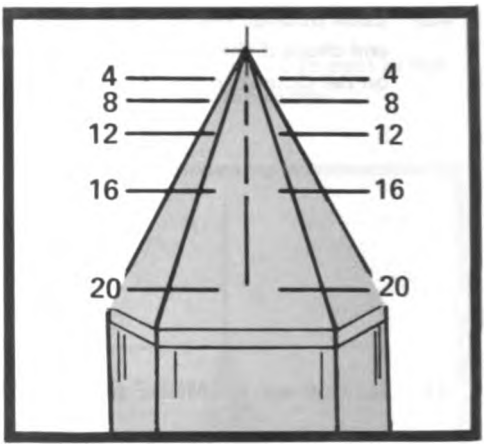
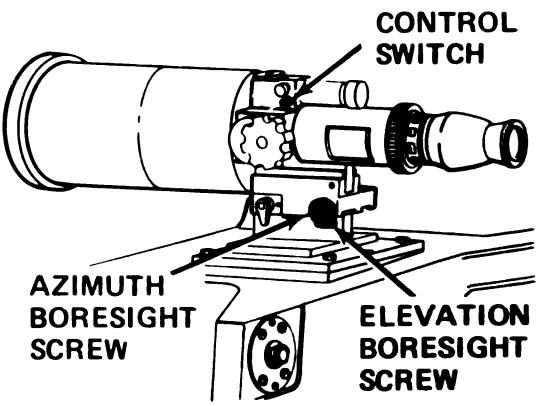
BORESIGHTING, DISTANT AIMING POINT METHOD – CONTINUED

49. Position cannon so that cross of M134 reticle is centered on distant aiming point.

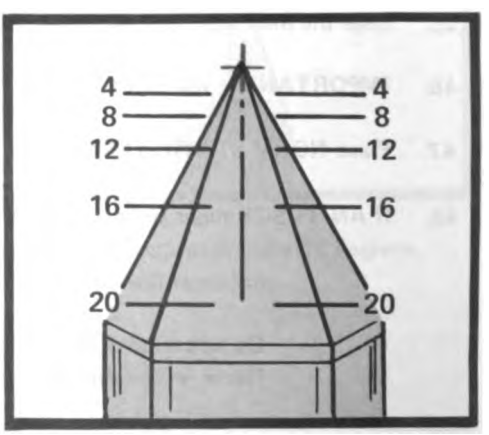


50. Turn night sight control switch to sight and reticle position. Open small aperture in lens cover. Do not allow sun to shine directly into the aperture.



51. Look through night sight and turn azimuth and elevation adjusting screws to center cross of reticle on the distant aiming point.

52. Close aperture and turn night sight control switch to off position.



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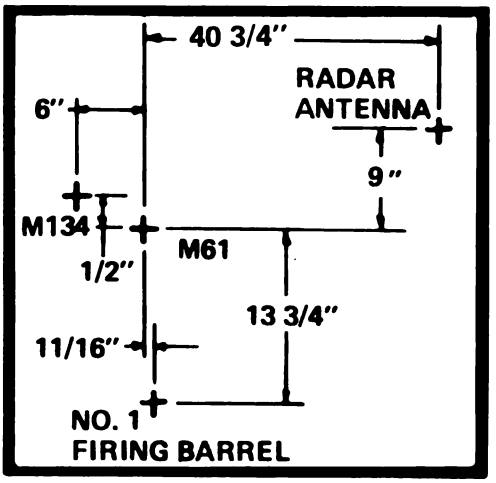
BORESIGHTING, TARGET METHOD

3-15. Use this method when visibility is limited (under 2500 meters).

1. Prepare a boresight target with measurements as shown (drawing is not to scale). Make the target on a sturdy flat surface.



2. Choose a level unobstructed area for boresighting.

3. Set GUN POWER switch to OFF and NORM-STATIC-TEST switch to NORM.

4. Remove arming connector from distribution box.

5. Clear cannon - hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE position and rotate cannon barrels two complete revolutions. Remove any rounds in case chute.

   NOTE: In step 6, time the cannon without regerd to the No. 1 barrel position if you are using a ground role (circular) muzzle clamp.

6. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE, depress cannon index pin, and position No. 1 barrel in firing position at 4 o'clock as viewed from muzzle end. Release switch and index pin. Check that pin has returned to normal (out) position.

7. Set SYSTEM POWER to ON and MODE switch to RADAR.

8. Train cannon towards proposed target location and position at approximately 0 mils elevation.

9. Position target 34 paces (approximately 1000 inches) from muzzle of cannon. Check that target is level and as square as possible with cannon, and that No. 1 BARREL aiming point on target is approximately same height as cannon.

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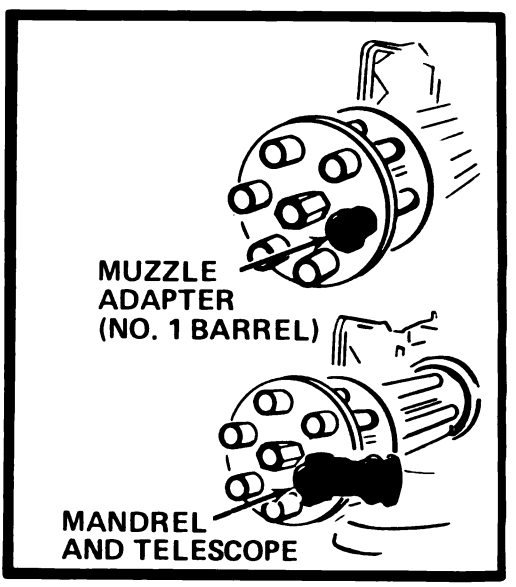
BORESIGHTING, TARGET METHOD–CONTINUED

10. Set distribution box NORM-STATIC-TEST switch to STATIC.

11. Set stow control MODE switch to NORMAL and MAINT switch to ON.

12. Insert muzzle adapter from boresight kit into muzzle of No. 1 barrel (4 o'clock position when viewed from muzzle end).

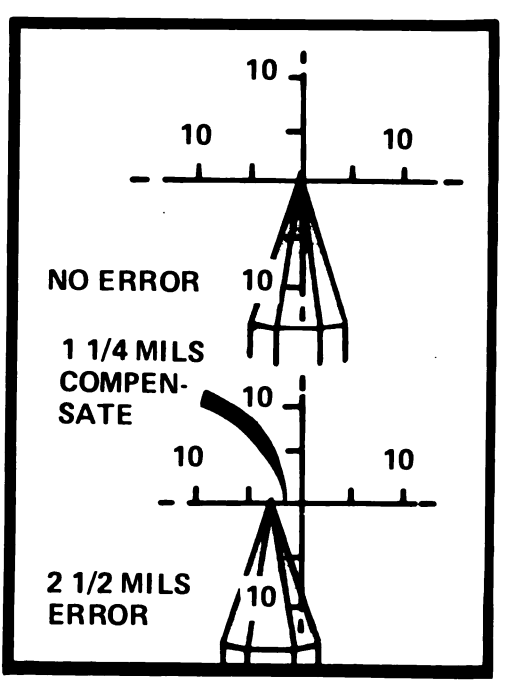
13. Make sure mandrel and boresight telescope are properly assembled, then insert the assembly into the muzzle adapter with eyepiece in horizontal position. Press mandrel assembly and adapter tightly into muzzle.



14. Release elevation and azimuth drive motor brakes.

15. Hold cannon down and to left. Sight through the telescope and line up crosshairs with a distinctive feature of a distant aiming point.

16. Rotate mandrel and telescope assembly 180 degrees to horizontal position on opposite side of barrel. Sight through telescope and determine if point originally sighted on is still at the crosshairs. If crosshairs are displaced over 5 mils from point sighted on, boresight kit is defective. If crosshairs are displaced less than 5 mils, continue to use the kit. Compensate for under 5 mil error by offsetting the crosshairs from aiming point by one-half of the error.



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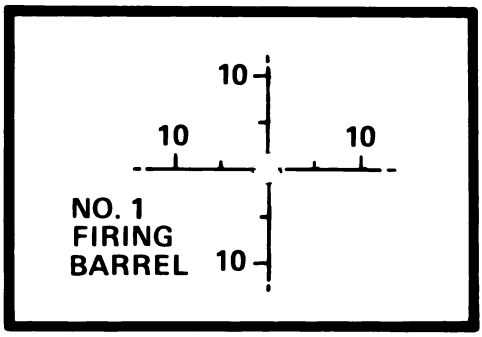
BORESIGHTING, TARGET METHOD – CONTINUED

17. Return telescope to vertical position. Hold cannon down and to left. Sight through the telescope and line up crosshairs with the No. 1 BARREL aiming point on the target.

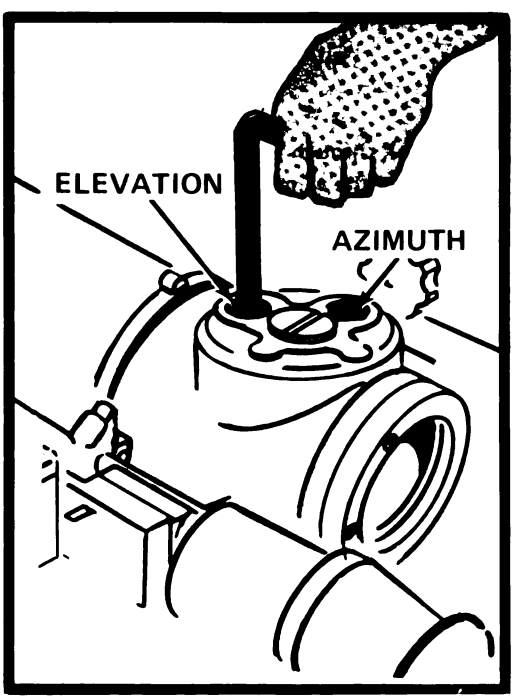


18. Check that cannon is still at approximately 0 mils elevation. Reposition cannon and target as required to align crosshairs and aiming point.

19. Lock the elevation and azimuth drive motor brakes and check that the cannon is still properly aimed.

20. Manually uncage the sight and adjust the control assembly SIGHT LAMP knob for a clear reticle in the sight.

21. Remove screw caps from the elevation and azimuth adjustment access holes on top of the sight. Do not disturb the third cap.



22. Have a second crewman look through the telescope as adjustments are being made to make sure that cannon does not move.

23. As you make the following adjustments, move your eye up and down, right and left to minimize the apparent shifting of the target. Watch the sight reticle and turn elevation and azimuth adjustment bolts until the inner sight reticle is centered on the M61 SIGHT aiming point.

24. Install the screw caps on the adjustment access holes.

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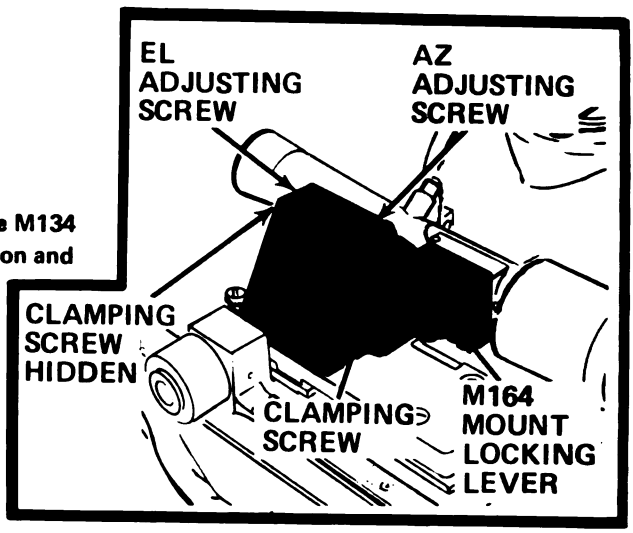
BORESIGHTING, TARGET METHOD – CONTINUED

25. If the M134 straight telescope is to be used, install it on the M164 mount according to page 2-75, and boresight it as follows:

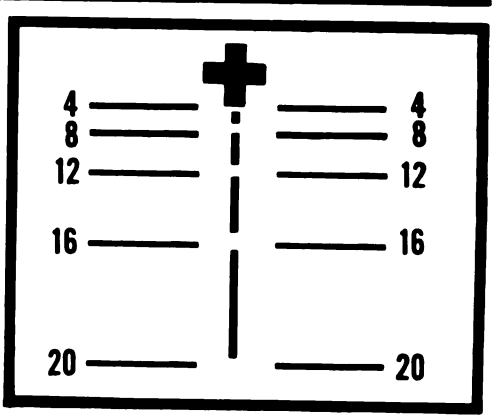
26. Remove the lens cap from the M134 telescope. Loosen the elevation and azimuth clamping screws.



27. Look through the M134 telescope and adjust the azimuth and elevation adjusting screws until the cross in the reticle is aligned with the M134 telescope aiming point on the target.

28. Tighten clamping screws and install lens cover.

29. Remove boresight telescope and mandrel assembly from muzzle adapter.



WARNING

Be sure to remove muzzle adapter from cannon barrel.

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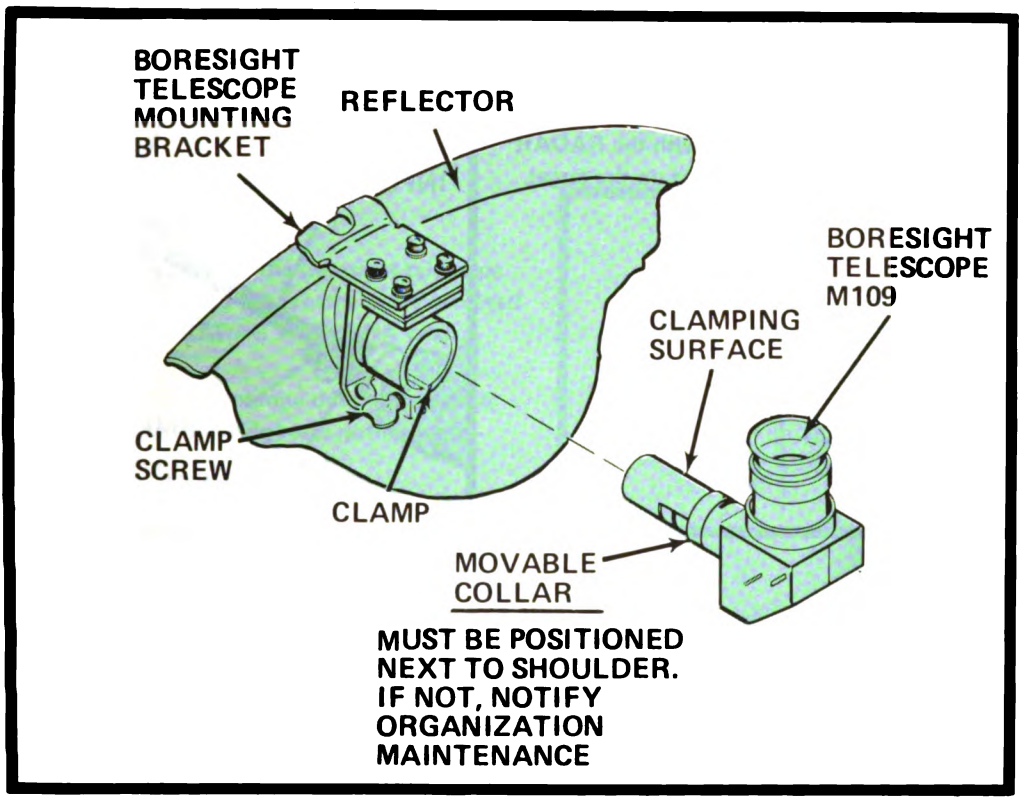
BORESIGHTING, TARGET METHOD–CONTINUED



30. Remove telescope from mandrel and install in the telescope mounting bracket on the antenna.

31. Use a second crewman to make sure that the M61 sight reticle is centered on the M61 sight aiming point before, during, and after the next adjustments.

IMPORTANT: Any pressure on antenna or telescope will cause error.

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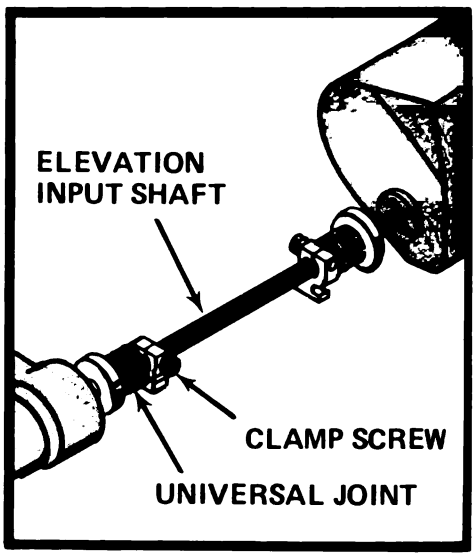
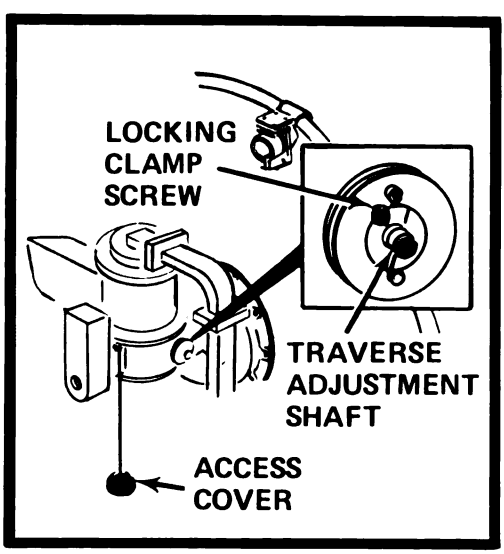
BORESIGHTING, TARGET METHOD – CONTINUED

32. On the elevation input shaft of the antenna, loosen universal joint clamp-screw. Rotate the input shaft to move horizontal crosshair of the telescope reticle into alignment with the RADAR ANTENNA aiming point on the target. Tighten the clamp screw.





33. Remove cover from traverse boresight adjustment. Loosen clamp screw and turn adjustment shaft until vertical crosshair is aligned with the RADAR ANTENNA aiming point on the target. Tighten clamp screw and replace cover.

34. Repeat steps 32 and 33 if necessary to center boresight telescope crosshairs on the RADAR ANTENNA target cross.

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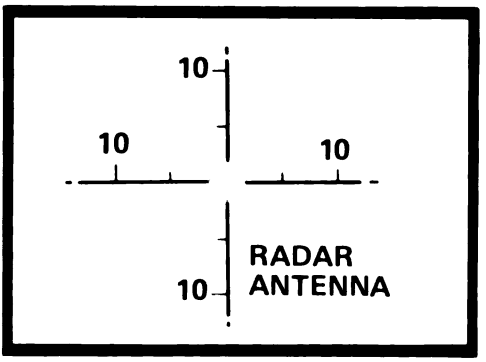
BORESIGHTING, TARGET METHOD – CONTINUED

36. Set stow control MODE switch to STOW.

37. Use stow control TRAV switch and drive the antenna approximately 10 degrees to the left. Set stow control MODE switch to NORMAL. Antenna will reposition.

35. Look through the boresight telescope and check if the crosshairs are centered on the RADAR ANTENNA cross.

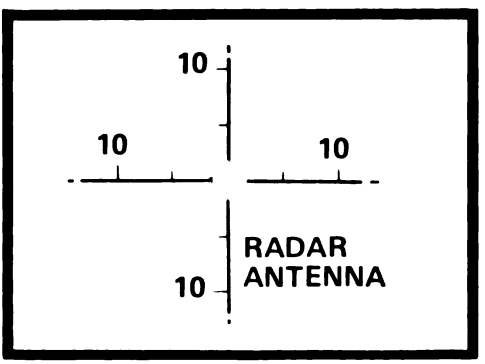
NOTE: If antenna does not respond in the following steps notify orgenizational maintenance.



39. Set stow control MODE switch to STOW.

40. Use stow control TRAV switch and drive the antenna approximately 10 degrees to right. Set stow control MODE switch to NORMAL. Antenna will reposition.

41. Look through the boresight telescope and check if crosshairs are centered on the RADAR ANTENNA cross.



42. Set stow control MODE switch to STOW.

43. Use stow control ELEV switch and drive the antenna up approximately 10 degrees. Set stow control MODE switch to NORMAL. Antenna will reposition.

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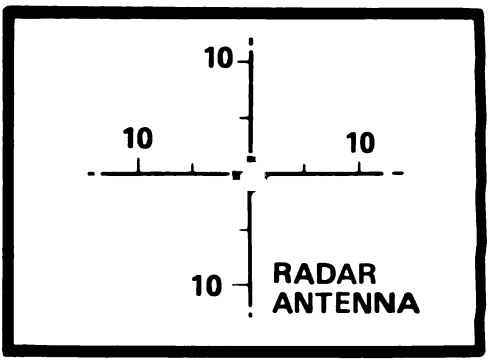
BORESIGHTING, TARGET METHOD—CONTINUED

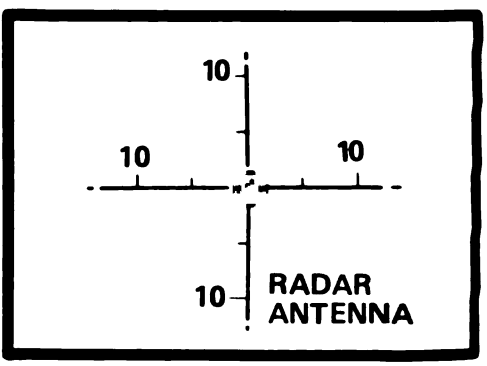
44. Look through the boresight telescope and check if crosshairs are centered on the RADAR ANTENNA cross.



45. Set stow control MODE switch to STOW.

46. Use stow control ELEV switch and drive the antenna down approximately 10 degrees. Set stow control MODE switch to NORMAL. Antenna will reposition.

47. Look through the boresight telescope and check if crosshairs are centered on the RADAR ANTENNA cross.



48. Set stow control MAINT switch to OFF. Remove tha boresight telescope from antenna and install cover over bracket.

49. Cage the M61 sight and set SYSTEM POWER switch to OFF.

50. IMPORTANT - recheck that there is nothing in the cannon muzzles.

51. Place NORM-STATIC-TEST switch to NORM and install arming connector.

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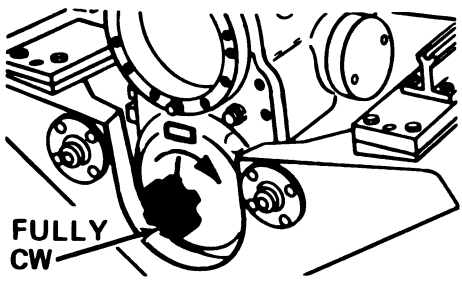
CHANGING RADAR FREQUENCY

3-16. To change the radar operating frequency, use the following procedure.

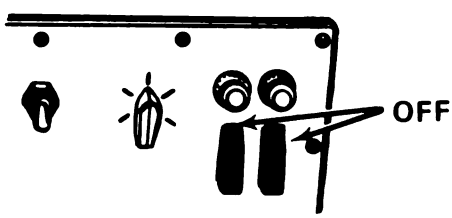
WARNING

High voltage is present in receiver-transmitter when energized in standby or radiate condition. Death or injury can result from contact with this high voltage. Observe safety precautions.

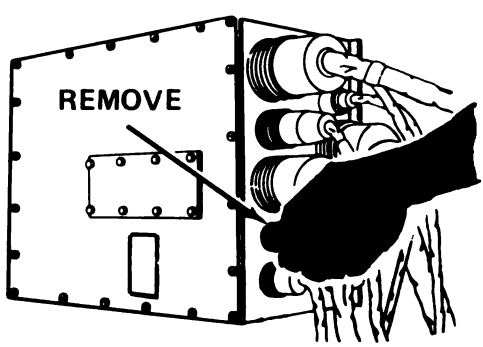
1. Turn knob on sight fully clockwise to cage sight.



2. Set control assembly GUN POWER and SYSTEM POWER switches to OFF.



3. Remove arming connector from power distribution box.



4. To gain access to receiver-transmitter, remove quick-release pin and fold back of gunner's seat down. Push pivot knob and swing seat out of way.

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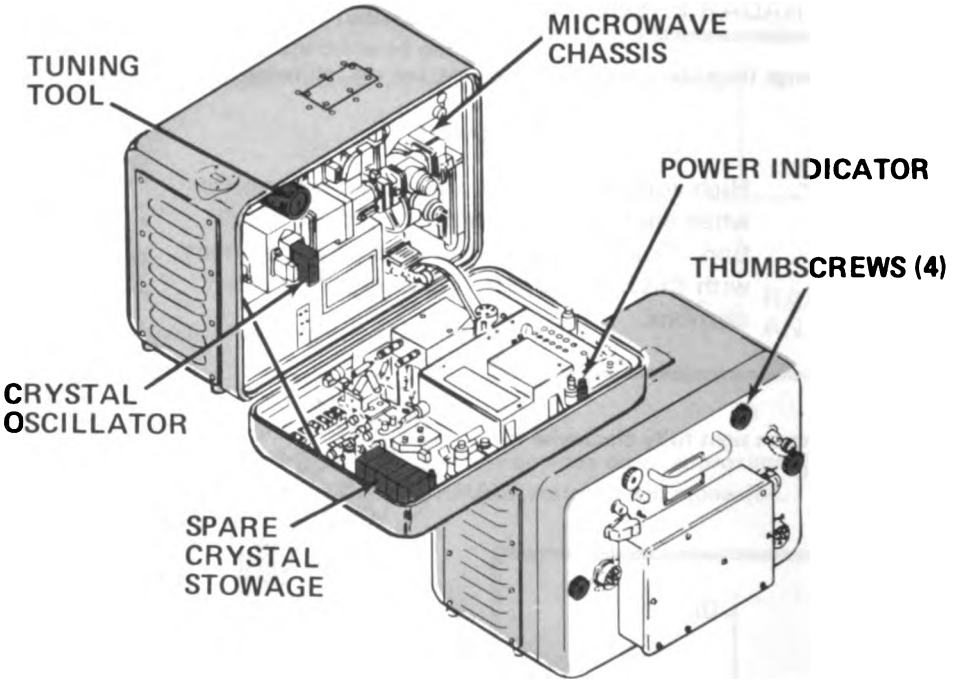
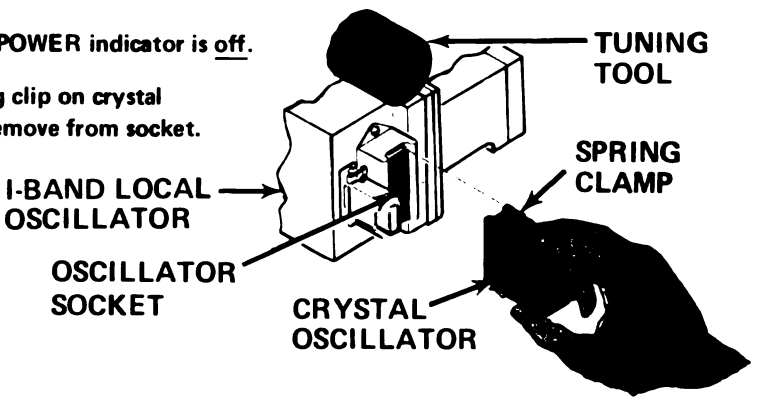
CHANGING RADAR FREQUENCY—CONTINUED



5. On receiver-transmitter, loosen four thumbscrew fasteners and lower front panel.

6. Make sure that POWER indicator is off.

7. Compress spring clip on crystal oscillator and remove from socket.



8. Select desired crystal oscillator from the spare crystals stowed in front panel and listed as follows:

Part Number	Channel Numbar	Crystal Frequency (MHz)
10549175	1	9145
10549176	2	9153
10549177	3	9161
10549178	4	9169
10549179	5	9177
10548224	6	9185

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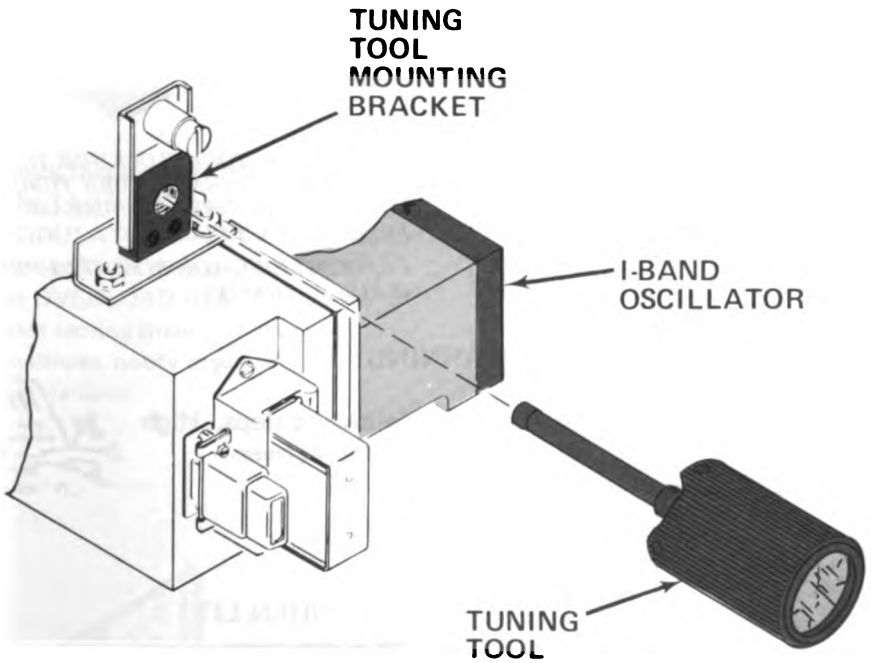
CHANGING RADAR FREQUENCY – CONTINUED

9. Line up the selected crystal oscillator with the socket and install.

10. Stow the crystal oscillator that was removed in the front panel spare crystal stowage area.

11. Remove tuning tool from its mounting bracket by turning tool counterclockwise.



CAUTION

Turning the cavity adjustment screws hard against the stops will damage the klystron. Improper tuning of the klystron power amplifier can shorten the tube life.

12. Push in on tuning tool and carefully adjust cavity tuning adjustments 1, 2, 3, and 5 until pointer on dial indicator is positioned to channel 3. Then adjust 1, 2, 3, and 5 until indicator is positioned to new operating frequency. The klystron is now coarse-tuned to new operating frequency.

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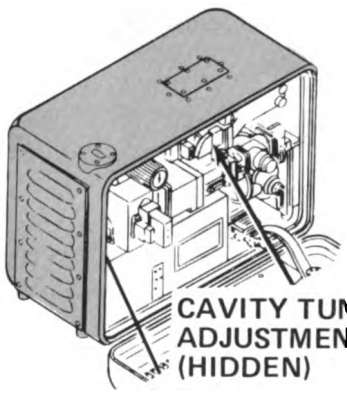
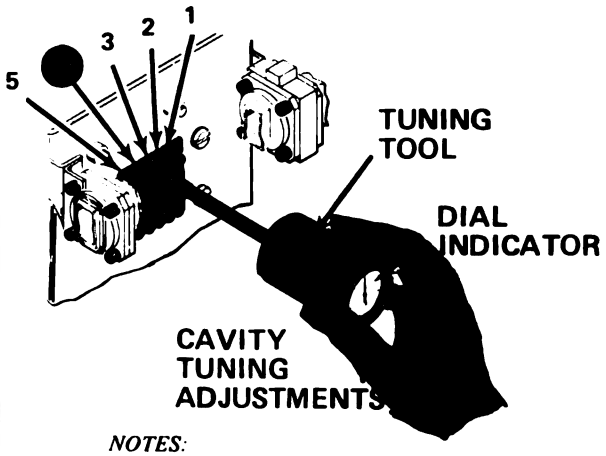
CHANGING RADAR FREQUENCY -CONTINUED





NOTES:

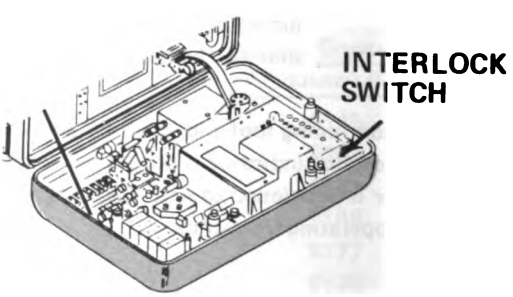
1. *TURN TUNING TOOL CLOCKWISE TO LOWER FREQUENCY CHANNEL. TURN TUNING TOOL COUNTERCLOCKWISE TO INCREASE FREQUENCY CHANNEL.*
2. *CAVITY TUNING ADJUSTMENT NUMBER 4 IS FIXED - TUNED.*

WARNING

Be very careful during the following steps. High voltage will be present when the receiver-transmitter is energized.

13. **Set control assembly SYSTEM POWER switch to ON. Set MODE switch to RADAR.**

14. **Pull receiver-transmitter interlock switch forward and out to service position. Receiver-transmitter is now energized. Wait until the READY WHEN LIT light goes on.**



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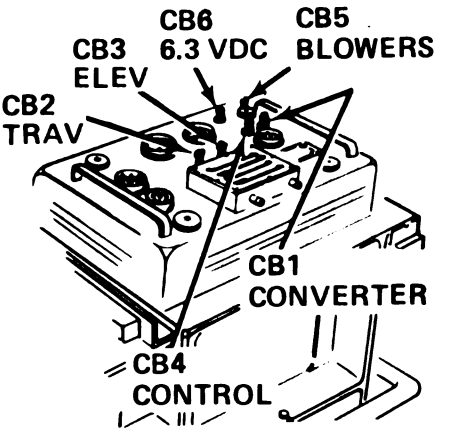
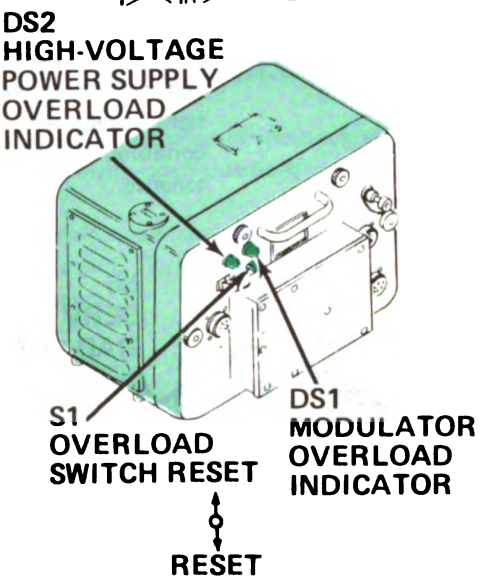
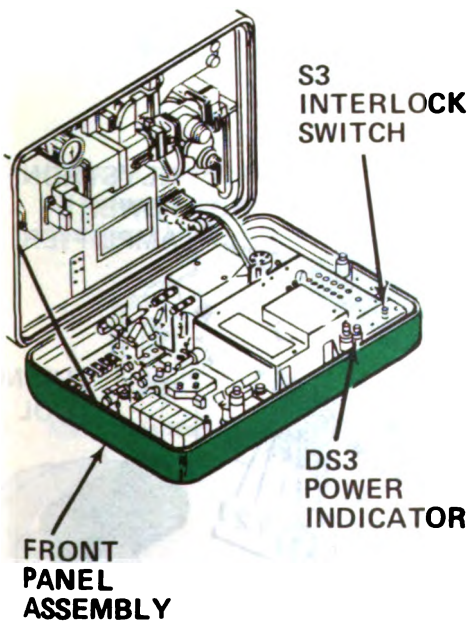
CHANGING RADAR FREQUENCY—CONTINUED

NOTE: If READY WHEN LIT indicator fails to light after two minutes ±15 seconds, or if it goes out during operation, check all circuit breakers on power supply front panel. If a breaker has tripped, as indicated by an exposad white band on extended pushbutton shaft, reset the breaker. If the breaker trips immediately, do not reset it again. Notify organizational maintenance.



15. Check that receiver-transmitter HIGH VOLTAGE SUPPLY OVERLOAD and MODULATOR OVERLOAD indicators are not lit. If they are, momentarily set OVERLOAD RESET to ON to reset sensing circuit. If overload continues, notify organizational maintenance.





16. Check that power indicator is lit - indicating power has been restored to unit. If power indicator is not lit, test lamp by pressing down on lens. If indicator still does not light, replace the lamp (page 3-112).

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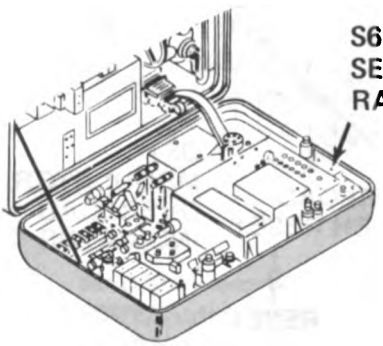
CHANGING RADAR FREQUENCY—CONTINUED

WARNING

A potential radiation hazard exists when the radar antenna is energized. Keep everyone at least three feet away from front of the radiating feed horn in the antenna dish.

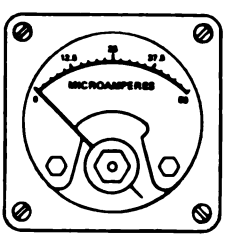
NOTE: When radiating, the following temporary condition may occur: The headset doppler tone suddenly stops - the READY WHEN LIT light, the sight ready-to-fire light, and the waveguide RF indicator go out. Immediately release the interlock switch, cage the sight (if uncaged), and set the MODE switch to GRD. Wait five seconds and reset MODE switch to RADAR, uncage the sight (if required), and continue the check. If condition persists, notify organizational maintenance.

17. Set SERV RAD CONT switch to ON. Radar is now energized to radiate.

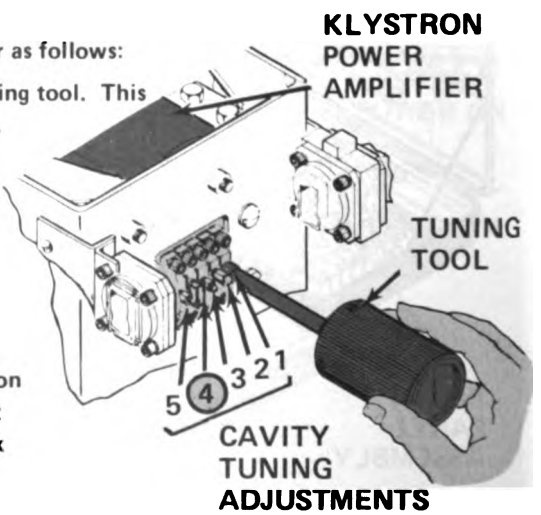


18. Fine tune the klystron power amplifier as follows:

IMPORTANT: Do not push in on tuning tool. This can damage the cavity.



RF POWER METER



(a) Watch the RF POWER METER on the microwave chassis and adjust cavity number 3 to obtain a peak reading.

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CHANGING RADAR FREQUENCY – CONTINUED

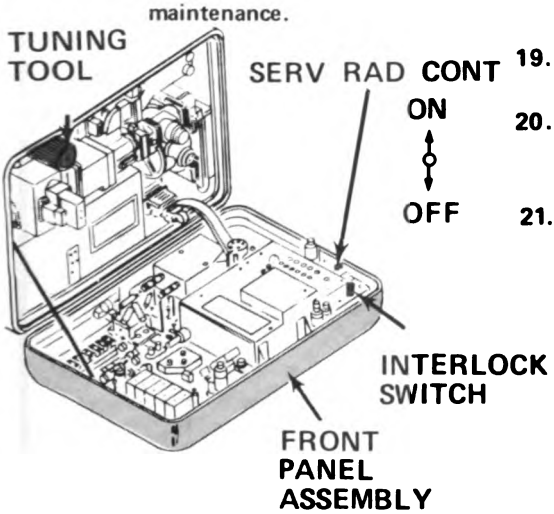
(b) Detune cavity numbar 3 by turning adjustment counterclockwise until RF POWER meter reading decreases to approximately 50 percent of step (a) peak reading.

(c) Peak cavities 1, 2, and 5 respectively to their peak RF POWER meter reading.

(d) Carefully tune cavity 3 clockwise for a peak RF POWER meter reading.

(e) Check that waveguide RF power indicator is lit.

NOTE: If the waveguide RF power indicator does not light, check receiver-transmitter overload indicators. If either overload indicator is lit, momentarily set OVERLOAD RESET switch to ON to reset sensing circuit. If OVERLOAD continues, notify organizational maintenance.



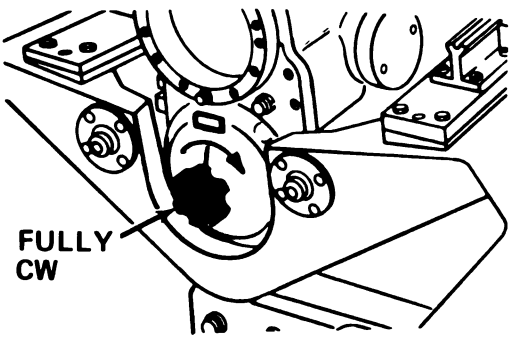
19. Set SER RAD CONT switch to OFF.

20. Push in actuator of interlock switch to normally open position.

21. Replace tuning tool in mounting bracket. Turn tool clockwise until secure.

22. Raise the receiver-transmitter front panel and secure with four thumbscrew fasteners. Lift gunner's seat back up and install quick-release pin. Swing seat back into place until pivot knob locks.

23. Make sure that the sight is caged.



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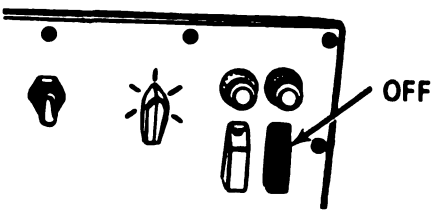
CHANGING RADAR FREQUENCY —CONTINUED

24. Set SYSTEM POWER switch to OFF. Install arming connector in power distribution box.



25. IMPORTANT: Make sure that all the daily Preventive Maintenance Checks and Services (PMCS) have been performed before firing (page 3-6).

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Section VI.
ROUND INTERVAL MAINTENANCE

3-17. Round interval preventive maintenance is based on the number of rounds cycled through the system, or fired through the system. Because of this, an accurate record must be maintained in the logbook of all rounds cycled, and all rounds fired.

3-18. Perform the maintenance on the items listed in table 3-3 at every interval as specified. Notify organizational maintenance when any of the procedures require their services. After completion of round interval maintenance procedures, make the appropriate entries in the applicable DA Forms contained in the logbook (page 3-2).

Table 3-3. Preventive Maintenance – Round Interval

Sequence No.	System rounds interval	Item to be inspected or procedure
* 1	Every 12,000 fired	Muzzle clamp bolt: torque to 600-650 in -lb.
2	Every 12,000 fired and/or cycled	Declutching feeder: notify organizational maintenance to replace feeder.
3	Every 18,000 fired and/or cycled	Cannon, M168: notify organizational maintenance for cannon servicing.
* 4	Every 18,000 fired	Breech bolts: notify organizational maintenance to rebuild.
5	Every 24,000 fired and/or cycled	Gun drive motor brake: If barrel cluster rotates, notify organizational maintenance.
6	Every 36,000 fired and/or cycled	Linkless feed drum: notify organizational maintenance.
7	Every 36,000 fired and/or cycled	Breech bolts: notify organizational maintenance to replace during cannon servicing.
* 8	Every 72,000 fired	Recoil adapters: notify organizational maintenance to replace.
* 9	Every 72,000 fired	Barrels: notify organizational maintenance to replace.
10	Every 72,000 fired and/or cycled	Guide bar and pins: notify organizational maintenance to replace.
11	Every 72,000 fired and/or cycled	Feeder lock pins: notify organizational maintenance to replace.
12	Every 72,000 fired and/or cycled	Conveyor elements: notify organizational maintenance to replace.
* 13	Every 144,000 fired	Cannon, M168: notify organizational maintenance to replace cannon.

* These components are dependent on rounds fired only.

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Section VII.
TROUBLESHOOTING

3-19. This section provides information useful in troubleshooting. Notify organizational maintenance of any problems for which no corrective action is given. Table 3-4 lists malfunctions, tests or inspections, and corrective actions which the crew can perform. Checks and inspections should be made in the order given. The following is a quick reference of symptoms covered in the table:

SYMPTOM INDEX

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– Doesn't crank	3-62
– Doesn't develop full power	3-64
– Overcools	3-64
– Overheats	3-63
– Runs rough or stalls	3-64
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SYMPTOM INDEX – CONTINUED

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Table 3-4. Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

NOTE

For corrective actions of malfunctions not listed in this table, notify organizational maintenance.

NOTE

Wherever the word lubricate appears, see LO 9-2350-300-10.

1. ENGINE AND THROTTLE CONTROLS

(1) Engine fails to crank when starter switch is held on.

- Is MASTER SWITCH turned ON? → If not, turn MASTER SWITCH ON.
- Is shift lever in N? → If not, place shift lever in N.
- Is chassis battery dead? → If so, charge batteries using APU (page 3-95).

(2) Engine cranks but fails to start.

- Is fuel flow valve turned on? → If not, turn on fuel flow valve (page 2-42).
- Does FUEL indicator show E (empty)? → If so, fill fuel compartment (page 2-35).
- Is fuel cutoff control pushed in? → If not, push in fuel cutoff control (page 2-42).
- If extremely cold weather, is air box heater on? → If not, operate air box heater (page 2-47).
- Is air cleaner restricted? → If so, service air cleaner element (page 3-92).

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Table 3-4. Troubleshooting – Continued

MALFUNCTION / TEST OR INSPECTION	CORRECTIVE ACTION
1. Engine and Throttle Controls - Continued	
If cold weather, is engine disconnect disengaged?	If not, disengage engine disconnect (page 2-45).
Is fuel improper or contaminated?	Service engine primary fuel filter; refer to LO 9-2350-300-10. If fuel is contaminated or improper, notify organizational maintenance.
(3) Engine oil HI TEMP LO PRESS indicator lights.	
CAUTION Do not operate engine with HI TEMP LO PRESS indicator light on.	
Is engine oil level low?	If so, add oil; refer to LO 9-2350-300-10, for correct oil level.
Is engine idling 550 to 600 rpm when warm?	If not, idle engine at 550 to 600 rpm.
Are there external oil leaks?	If so, try to stop by tightening components. If leaks cannot be stopped, notify organizational maintenance.
(4) Engine overheats as indicated by TEMP F indicator.	
Is coolant level low?	If so, fill radiator with coolant (page 2-33).
Is air intake grille restricted?	If so, clean air intake grille.
Are radiator fins restricted?	If so, clean radiator fins.
Are hull drain plugs or access plates installed?	If not, install hull drain plugs or access plates (page 2-59).
Is engine disconnect engaged?	If not, engage engine disconnect (page 2-49).

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Engine and Throttle Controls - Continued		
(5) Engine overcools as indicated by TEMP F indicator.		
	If cold weather, is intake and exhaust grille cover installed?	If not, install intake and exhaust grille cover, and adjust flaps (page 2-13).
(6) Engine does not develop full power.		
	If hot weather, is engine oil level too high?	If so, refer to LO 9-2350-300-10 for correct oil level.
	Is air cleaner restricted?	If so, service air cleaner element (page 3-92).
(7) Engine runs rough or stalls frequently.		
	Is engine disconnect engaged?	If not, engage engine disconnect (page 2-45).
	Is fuel pressure low?	If so, check for clogged fuel filter or fuel lines.
(8) Engine oil consumption abnormal.		
	Are oil lines, connections, or seals leaking?	If so, try to stop by tightening components. If leaks cannot be stopped by tightening components, notify organizational maintenance.
2. FUEL AND AIR INTAKE SYSTEMS		
(1) Fuel consumption abnormal.		
	Are fuel lines, connections, or fuel compartment leaking?	If so, try to stop by tightening components. If leaks cannot be stopped by tightening components, notify organizational maintenance.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Fuel and Air Intake Systems - Continued		
(2) Engine cranks but fails to start when air box heater is operating and temperature is below 40°F.		
	Is accumulator fuel pressure low?	If so, pump up accumulator fuel pressure (page 2-45).
	Are air box fuel lines or connections leaking?	If so, try to stop by tightening components. If leaks cannot be stopped by tightening components, notify organizational maintenance.
3. EXHAUST SYSTEM		
	WARNING Exhaust fumes are dangerous and can cause death. Notify organizational maintenance immediately if fumes are found in vehicle.	
(1) Exhaust fumes in vehicle.		
	Are engine access panels installed properly?	If not, properly install engine access panels. If fumes still exist, notify organizational maintenance.
4. ELECTRICAL SYSTEM		

NOTE

A battery check should be a part of any malfunction test or inspection where vehicle electrical power is involved. To check condition of vehicle batteries, turn MASTER SWITCH to ON and check BATTERY-GENERATOR meter on vehicle control panel. If pointer is down to left in red zone, battery is discharged. Charge batteries with APU (see page 3-95).

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
4. Electrical System - Continued		
(1) MASTER SWITCH ON indicator fails to light when vehicle MASTER SWITCH is turned ON.	Does BATTERY-GENERATOR meter show that batteries are dead?	If so, charge batteries with APU (page 3-95).
(2) ENGINE OIL-HI TEMP LO PRESS indicator fails to light.	Does BATTERY-GENERATOR meter show that batteries are dead?	If so, charge batteries with APU (page 3-95).
NOTE With MASTER SWITCH turned ON, ENGINE OIL HI TEMP LO PRESS indicator should light until engine starts.		
(3) BATTERY-GENERATOR indicator fails to operate with MASTER SWITCH ON.	Are the chassis batteries dead or defective?	Try to charge batteries with APU (page 3-95). If batteries prove defective, notify organizational maintenance.
(4) FUEL indicator fails to register when MASTER SWITCH is turned ON, even though fuel compartment has fuel in it.	Does BATTERY-GENERATOR meter show that batteries are dead?	If so, charge batteries with APU (page 3-95).

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Table 3-4. Troubleshooting–Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
4. Electrical System - Continued		
(5) Continuous high or low battery charging rate as indicated by BATTERY-GENERATOR indicator.	Is electrolyte level in chassis batteries low?	If so, service batteries (page 3-93).
(6) Chassis batteries discharged.	Is electrical equipment operated too much without running engine?	If so, run engine or APU with vehicle MASTER SWITCH on during extended operation of electrical equipment.
	Is electrolyte level low?	If so, service batteries (page 3-93).
(7) Engine TEMP F indicator fails to register.	Does BATTERY-GENERATOR meter show that batteries are dead?	If so, charge batteries with APU (page 3-95).
(8) Horn fails to sound.	Does BATTERY-GENERATOR meter show that batteries are dead?	If so, charge batteries with APU (page 3-95).
(9) M19 periscope inoperative.	Is M19 periscope properly installed?	If not, install correctly (page 2-136).

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Table 3-4. Troubleshooting – Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
5. TRANSMISSION		
	NOTE Notify organizational maintenance of any unusual noises, odors, or malfunctions of the transmission.	
(1) TRANS OIL HI TEMP indicator lights.		
	CAUTION Do not operate vehicle with TRANS OIL HI TEMP indicator light on.	
	Is transmission oil level correct?	Refer to LO 9-2350-300-10 for correct oil level.
	Is vehicle being driven properly?	If not, read and observe driving precautions (page 2-54).
(2) Engine operates properly but chassis fails to move with shift lever in any position.		
	Is engine disconnect engaged?	If not, engage engine disconnect (page 2-49).
	Is transmission oil level low?	If so, add oil; refer to LO 9-2350-300-10 for correct oil level.
6. TRANSFER GEARCASE		
(1) No power transmitted through transfer gearcase although engine is running.		
	Is engine disconnect engaged?	If not, engage engine disconnect (page 2-49).

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
6. Transfer Gearcase - Continued		
(2) Transfer gearcase overheating.	Is gearcase oil level low?	If so, refer to LO 9-2350-300-10 for correct oil level.
(3) Transfer gearcase excessively noisy.	Is gearcase oil level low?	If so, refer to LO 9-2350-300-10 for correct oil level.
7. CONTROL DIFFERENTIAL AND FINAL DRIVES		
(1) DIF OIL HI TEMP indicator light comes on.	CAUTION Do not operate vehicle with DIF OIL HI TEMP indicator light on. Is differential oil level low or breather restricted?	If so, refer to LO 9-2350-300-10 for correct oil level and service of breather.
(2) Power train noisy during operation.	Do drive shafts need lubrication?	If so, refer to LO 9-2350-300-10 for lubrication of drive shafts.
8. TRACKS AND SUSPENSION		
(1) Vehicle pulls to one side.	NOTE Vehicle normally pulls to low side of crowned road or sloping terrain.	

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Table 3-4. Troubleshooting - Continued

MALFUNCTION → TEST OR INSPECTION	CORRECTIVE ACTION
8. Tracks and Suspension - Continued	
Is track tension unequal?	If so, check and adjust track tension (page 3-88).
Has mud or dirt built up on one track?	If so, clean tracks.
Are track components worn or damaged?	If so, check and replace worn or damaged track shoes. Check for worn bushings by running chassis slowly and observing track shoes as they pass over road wheels one and two. Track shoes with worn bushings hang lower than other shoes (page 3-90).
(2) Vehicle throws track.	
Is foreign material lodged in track or between sets of road wheels or idler wheels.	If so, clean suspension system of foreign material.
Is vehicle being driven properly?	If not, read and observe driving precautions (page 2-58).
Are tracks excessively loose or worn?	Adjust track tension on loose tracks. Replace worn or damaged track shoes. Check for worn bushings by running chassis slowly and observing track shoes as they pass over road wheels one and two. Track shoes with worn bushings hang lower than other shoes (page 3-88).
(3) Thumping noise heard during chassis operation.	
Are there worn bushings in one or more track shoes?	If so, replace worn or damaged track shoes (page 3-90).

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
8. Tracks and Suspension - Continued		
	Are one or more track pads assembled wrong or missing?	If so, reassemble correctly and replace worn, damaged, or missing pads. (page 3-90).
(4) Excessive noise in tracks or suspension during vehicle operation.		
	Are wheel hubs excessively hot immediately after vehicle operation? Excessive heat can be determined by comparative check of hubs.	If so, notify organizational maintenance.
	Are track bushings worn?	If so, replace worn or damaged track shoes (page 3-90).
9. PIVOT STEER CONTROLS		
(1) Pivot steer brake inoperative when control lever is applied.		
	Is fluid in master cylinders low?	If so, refer to LO 9-2350-300-10 for correct fluid level.
	Are hydraulic lines or connections leaking?	If so, try tightening. If leaks cannot be stoppad by tightening, notify organizational maintenance.
(2) Pivot steer brakes do not release.		
	Are the master cylinders filler caps breather holes restricted?	If so, clean breather hole in one or both master cylinder filler caps.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
10. SHOCK ABSORBERS		
(1) Vehicle rides excessively hard.		
	Is suspension locked out?	If so, release suspension lockout (page 2-56).
11. RAMP HYDRAULIC SYSTEM		
(1) Ramp fails to rise.		
	Is hydraulic tank fluid level low?	If so, refer to LO 9-2350-300-10 for correct fluid level.
	Are hydraulic lines or connections leaking?	If so, try tightening. If leaks cannot be stopped by tightening, notify organizational maintenance.
	Is engine disconnect disengaged?	If so, engage engine disconnect.
(2) Ramp operation slow or sluggish.		
	Is vehicle engine speed too low?	If so, increase vehicle engine speed.
	Is ramp hydraulic tank fluid level low?	If so, refer to LO 9-2350-300-10 for correct fluid level.
	Are hydraulic lines or connections leaking?	If so, try tightening. If leaks cannot be stopped by tightening, notify organizational maintenance.
(3) Ramp fails to lower.		
	Is ramp frozen shut (cold weather)?	If so, thaw ramp.
12. BILGE PUMPS		
(1) Bilge pump runs but fails to pump water.		

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Table 3-4. Troubleshooting – Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
12. Bilge Pumps - Continued		
	Is pump air locked?	Turn BILGE PUMPS switch ON and OFF to clear.
	Is pump inlet screen restricted?	If so, clean bilge pump inlet screen (page 3-107).
	Is discharge line restricted?	If so, clean bilge pump outlet tubes (page 3-107).
13. INSTRUMENTS		
(1) SUSP LOCKED OUT light does not light.		
	Is hydraulic tank oil level low?	If so, refer to LO 9-2350-300-10 for correct level.

IMPORTANT: - Malfunction of the mount can be due to discharged batteries. A battery check should be part of any malfunction test or inspection where mount electrical power is involved. To make a quick check of mount batteries, start vehicle engine and check ammeter on system power distribution box. If ammeter reads approximately ten amperes or less, consider the batteries charged. If batteries are partially or completely discharged (dead), the ammeter reading will be proportionately higher. Recharge discharged batteries according to page 3-95.

IMPORTANT: - Check that all cables are properly connected, secured, and undamaged.

14. MOUNT		
(1) Control assembly SYSTEM POWER indicator fails to light when SYSTEM POWER switch is set to ON position.		
	Is blackout shutter closed?	If so, open blackout shutter.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
14. MOUNT - Continued		
	Press indicator to test lamp.	If defective, replace lamp (page 3-111).
	CAUTION Do not reset a circuit breaker more than once. If circuit breaker fails to reset, notify organizational maintenance.	
	Is SYS PWR circuit breaker on distribution box tripped?	If so, press circuit breaker to reset.
	Are cables disconnected or loose?	If so, reconnect and/or tighten cable connections.
	Are batteries dead?	If so, recharge batteries (page 3-95).
(2) Both azimuth and elevation drives fail to respond when action switch is depressed and elevation and azimuth controls are rotated.		
	Is distribution box NORM-STATIC-TEST switch set to NORM position?	If not, set switch to NORM (up position).
	Is control panel SYSTEM POWER switch set to ON position?	If not, set switch to ON position.
	Is conveyor unit in fire position?	If not, place conveyor unit in fire position (down and locked).
	Is shift pin in F position?	If not, set shift pin in F position.

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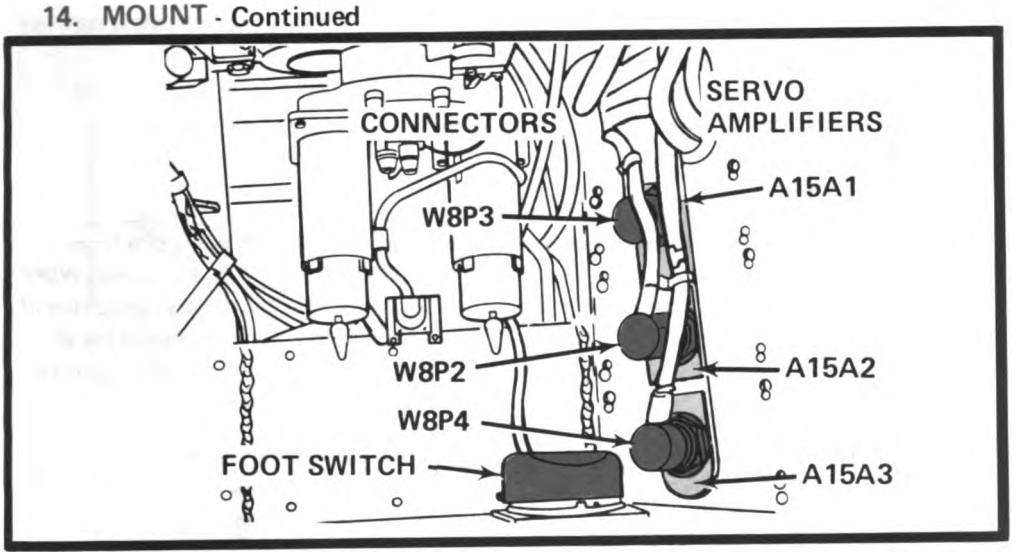
Table 3-4. Troubleshooting – Continued

MALFUNCTION / TEST OR INSPECTION	CORRECTIVE ACTION

14. MOUNT - Continued



(3) Elevation drive responds when action switch is depressed but azimuth drive does not respond.

- None → Disconnect W8P3 and W8P2 from A15A1 and A15A2. Reconnect W8P3 to A15A2 for possible operation at reduced slew speed. Notify organizational maintenance.
- Are servo amplifier connectors disconnected or loose? → If so, connect or tighten.

(4) Elevation drive responds when action switch is depressed but azimuth drive has uncontrolled response.

- None → Disconnect W8P2 from A15A2. If malfunction still exists, disconnect W8P3 from A15A1 and reconnect to A15A2 for possible operation at reduced slew speed. Notify organizational maintenance.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
14. MOUNT - Continued		
(5) Azimuth drive responds when action switch is depressed but elevation drive does not respond or has uncontrolled response.		
	None	Disconnect W8P2 and W8P4 from A15A2 and A15A3. Reconnect W8P4 to A15A2 for temporary correction of elevation problem and operation at reduced slew speed. Notify organizational maintenance.
	Are servo amplifier connectors disconnected or loose?	If so, connect or tighten.
(6) Loading motor does not work when loading switch is set to either ON or MOMENTARY ON position.		
	Is drum full?	Check visually for full drum.
	Is conveyor unit in LOAD position?	If not, lock conveyor unit in LOAD (out) position.
	Are cable connectors loose?	If so, tighten cable connectors.
(7) Loading motor energizes but drum fails to load.		
	Is ammunition jammed?	If so, remove ammunition from loading chute. Detect and release jam. Insure rounds are correctly linked and proper loading procedures followed (page 2-82).
	Is shift pin handle in L position?	If not, set shift pin handle in L position.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
14. MOUNT - Continued		
(8) Conveyor unit assembly cannot be set in fire position (in toward exit unit assembly).		
	Is double link stripping guide fully out?	If not, slide double link stripping guide out to lock position.
	Is conveyor unit timed?	If not, time conveyor unit (page 2-79).
	Is round timed in exit unit?	If not, time round in exit unit (page 2-79).
15. CANNON		
(1) GUN POWER indicator fails to light when GUN POWER switch is set to ON.		
	Is control assembly SYSTEM POWER switch set to ON position?	If not, set SYSTEM POWER switch to ON.
	Is blackout shutter closed?	If so, open blackout shutter.
	Press indicator to test lamp.	If defective, replace lamp (page 3-111).
(2) Cannon cannot be rotated with BRAKE-CLEAR AND BRAKE switch set to CLEAR AND BRAKE position.		
	Is shift pin in F position?	If not, adjust slack point in feed chute and place shift pin in F position (page 2-85).
	Is indexing pin on cannon free?	If not, free indexing pin (page 2-27).

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
15. Cannon - Continued		
	Is indexing pin on feeder free?	If not, free indexing pin (page 2-27).
	Is cable to BRAKE-CLEAR AND BRAKE switch disconnected or loose?	If so, connect or tighten.
	CAUTION Do not reset a circuit breaker more than once. If circuit breaker fails to reset, notify organizational maintenance.	
	Is SYS PWR circuit breaker on distribution box tripped?	If so, press circuit breaker to reset.
	Is W3 cable on gun drive assembly and/or distribution box loose or disconnected?	If so, connect and/or tighten cable W3 connectors.
(3) SYSTEM POWER and GUN POWER indicators light but cannon fails to rotate.		
	Is drum assembly empty?	If so, load drum assembly (page 2-77).
	Is arming connector or arm-safe switch missing from distribution box?	If so, install arming connector or arm-safe switch on distribution box (page 2-29).
	Is arm-safe switch closed (when used)?	If not, depress arm-safe switch (page 2-29).
	Is shift pin in F position?	If not, set shift pin in F position.
	Is conveyor locked in fire position?	If not, set conveyor in fire position (down and locked).
	Is cable W3 connected to gun drive assembly and/or distribution box?	If not, connect cable W3 to gun drive assembly and/or distribution box.

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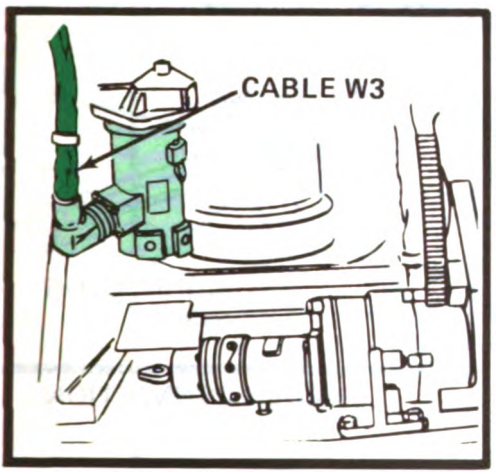
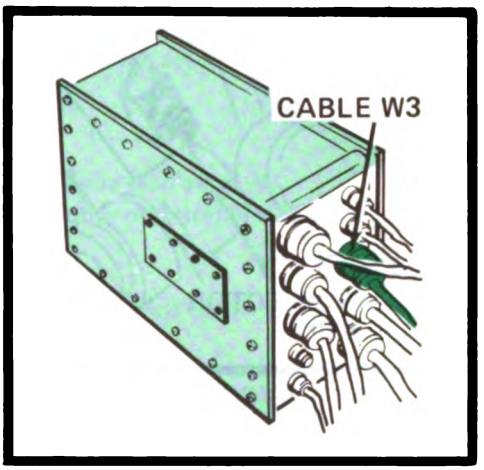
Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

15. Cannon - Continued



GUN DRIVE ASSEMBLY



DISTRIBUTION BOX

WARNING

Clear cannon of all rounds before working on any part of firing mechanism. If cannon cannot be cleared, keep it positioned in a direction so that possible loss of life or damage to property will not result if ammunition cook-off should occur.

(4) Cannon rotates, rounds feed through but do not fire.

Is firing connector W3P2 connected to firing contact assembly? → If not, connect W3P2 to firing contact assembly.

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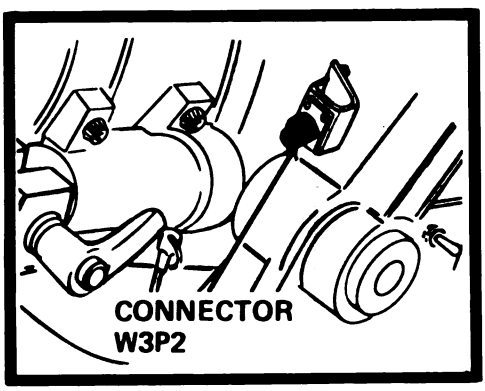
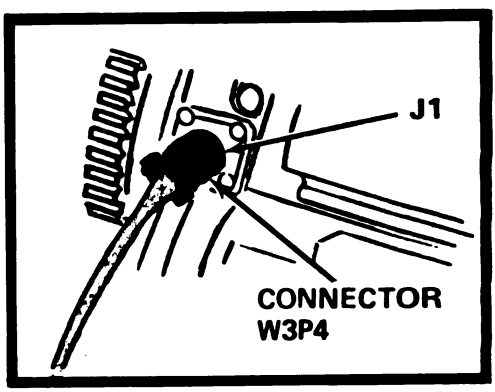
Table 3-4. Troubleshooting –Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

15. Cannon - Continued



FIRING CONTACT ASSY



FEEDER CONNECTION

(5) Cannon fires normally but does not clear with GUN CLEAR switch in AUTO or OPERATOR position.

→ Is connector W3P4 connected to feeder? → If not, connect W3P4 to feeder connector J1.

(6) Cannon misfires

→ Are breech bolt assembly/s damaged? → If so, replace breech bolt assembly/s (page 3-101).

(7) Slow or erratic rate of fire.

→ Is cannon lubricated? → If not, clean and lubricate cannon (page 3-97).

→ Are batteries charged? → If not, recharge mount batteries (pages 3-94, or 3-95).

→ Is APU output correct? → If not, adjust (page 3-95).

16. SIGHTING AND FIRE CONTROL

(1) No lead angle is developed in manual mode.

→ Is W6 cable to sight disconnected or loose? → If so, connect or tighten.

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Table 3-4. Troubleshooting—Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. Sighting and Fire Control - Continued		
	Is sight mechanically uncaged?	If not, uncage sight after system power has been applied for 10 seconds.
	CAUTION Do not reset a circuit breaker more than once. If circuit breaker fails to reset, notify organizational maintenance.	
	Is SCG PWR circuit breaker on distribution box tripped?	If so, press circuit breaker to reset.
(2) Wrong lead angle developed in manual mode.		
	Is MODE switch on stow control set to NORMAL?	If not, set MODE switch to NORMAL.
	Are SCG PWR, INVERTER PWR, and/or SIGHT GYRO PWR circuit breakers on system distribution box tripped?	If so, press circuit breakers to reset.
(3) In radar mode, READY WHEN LIT indicator fails to light within 2 minutes ± 15 seconds after SYSTEM POWER switch is set to ON.		
	Is cover on radar receiver-transmitter securely closed?	If not, securely close cover and tighten thumb-screws.
	Press indicator to test lamp.	If defective, replace lamp (page 3-111).

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Table 3-4. Troubleshooting—Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. Sighting and Fire Control - Continued		
	Are CONVERTER and/or CONTROL CKT circuit breakers on radar power supply tripped?	If so, press circuit breakers to reset.
(4) Antenna does not respond to positioning commands.		
	Is MODE switch on stow control set to NORMAL?	If not, set MODE switch to NORMAL.
	Are TRAV and/or ELEV circuit breakers on radar power supply tripped?	If so, press circuit breakers to reset.
	Is cable connector W7P2 disconnected from stow control jack J2?	If so, reconnect cable.
	Is INVERTER PWR circuit breaker on system distribution box tripped?	If so, press circuit breaker to reset.
(5) RF POWER indicator lamp fails to light when footswitch is pressed in RADAR mode.		

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Table 3-4. Troubleshooting – Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. Sighting and Fire Control - Continued		
	CAUTION Do not attempt to reset OVERLOAD switch with foot switch depressed; damage to radar will result.	
	Is OVERLOAD RESET switch on radar receiver-transmitter tripped?	If so, reset OVERLOAD RESET switch.
	Are one or more circuit breakers on radar power supply tripped?	If so, press circuit breaker to reset.
	Is indicator lamp defective?	If defective, replace lamp.
	Is klystron power amplifier tuned properly (low output)?	Check klystron power amplifier tuning (page 3-51).
	None	Crystal oscillator subassembly may be defective. Change radar frequency if situation permits (page 3-51).
(6) HIGH VOLTAGE POWER SUPPLY OVERLOAD or MODULATOR OVERLOAD indicators light.		
	Is OVERLOAD RESET switch on radar receiver-transmitter tripped?	If so, reset OVERLOAD RESET switch.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. Sighting and Fire Control - Continued		
(7) POWER indicator lamp in receiver-transmitter does not light when radar is energized to STANDBY with INTERLOCK switch placed in SERVICE position.	Press indicator to test lamp.	If defective, replace lamp.
(8) Abnormal indication of RF power meter during tuning of klystron power amplifier.	None	Crystal oscillator subassembly may be defective. Change radar frequency if situation permits (page 3-51).
(9) GOOD WHEN LIT indicator fails to light during sight current generator test.	Press indicator to test lamp.	If defective, replace lamp.
	Is cannon position at 0° elevation?	If not, position cannon at 0° elevation.
	Are AIR DENSITY or MUZZLE VELOCITY knobs set properly?	If not set knobs properly (pages 2-91 or 2-92).
	Is radar antenna aligned with cannon?	If not, set stow control MODE switch to NORMAL or boresight antenna.

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Table 3-4. Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
16. Sighting and Fire Control - Continued		
(10) M61 sight reticle lamp does not light.		
	Is lamp defective?	If so, replace lamp.
	Is cable connection loose?	If so, tighten cable connector.
	Is INVERTER PWR circuit breaker on system distribution box tripped?	If so, press circuit breaker to reset.
(11) Unable to obtain audio tone during clutter lockon test.		
	None	Replace CVC helmet (or headset).

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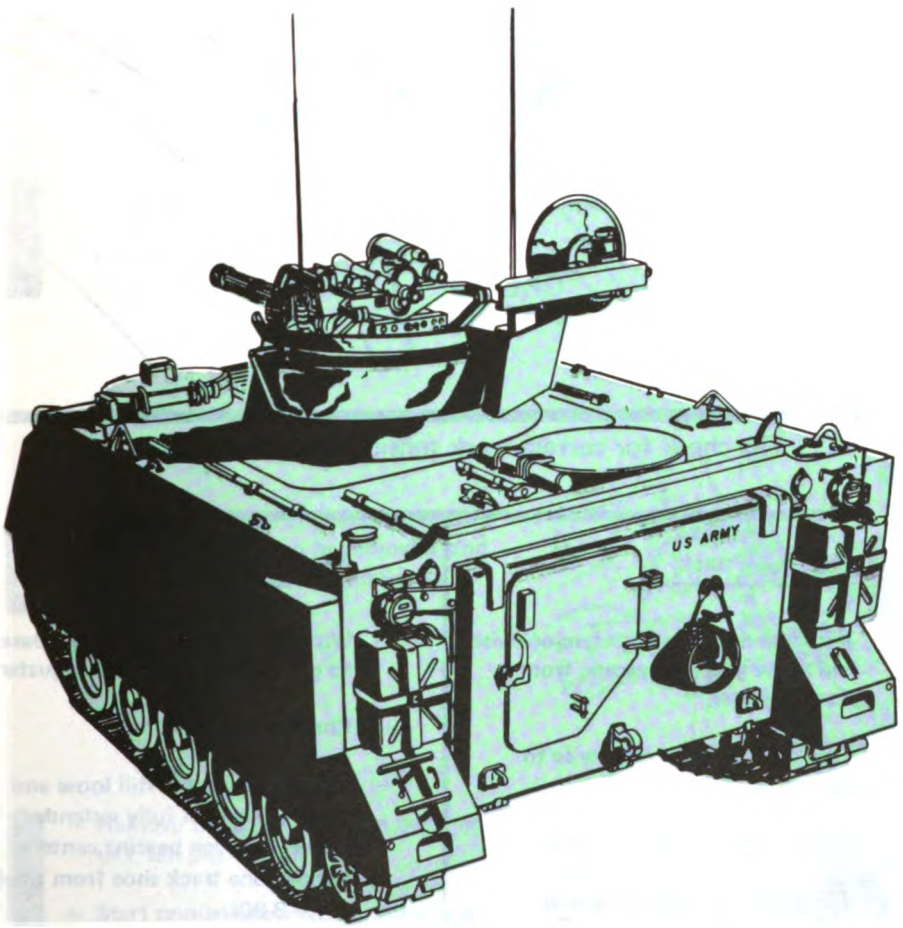
SECTION VIII. CORRECTIVE MAINTENANCE

3-20. This section contains maintenance and service instructions that you can perform.

3-21. Crew maintenance in this section covers M741 chassis, M168 cannon, M157 mount, and AN/VPS-2 radar set. When performing any kind of maintenance, always observe the applicable general procedures given at the beginning of Section IV, page 3-4.



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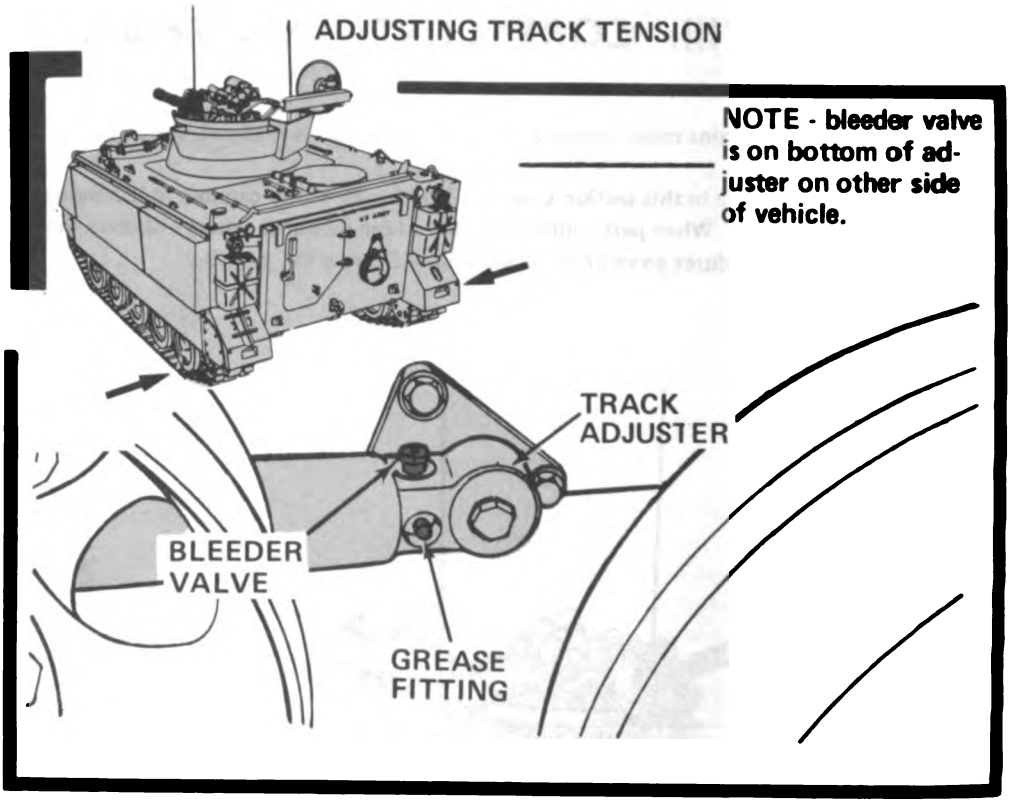
TRACK MAINTENANCE

ADJUSTING TRACK TENSION



To check for correct track tension, see page 3-13.

To Loosen track:

- Turn bleeder valve counterclockwise and allow grease to escape from track adjuster.
- Turn bleeder valve clockwise to close.
- Check track tension.
- If track tension is still tight and track adjuster is fully retracted, 13 1/2 inches between bearing centers, add one track shoe to track (page 3-90).

To tighten track:

- With grease gun, add GAA grease to grease fitting on track adjuster.
- Check track tension.
- If track tension is still loose and track adjuster is fully extended, 17 inches between bearing centers, remove one track shoe from track (page 3-90).
- IMPORTANT – After vehicle is operated for a time with a new track, the track will stretch enough to fully extend track adjuster.

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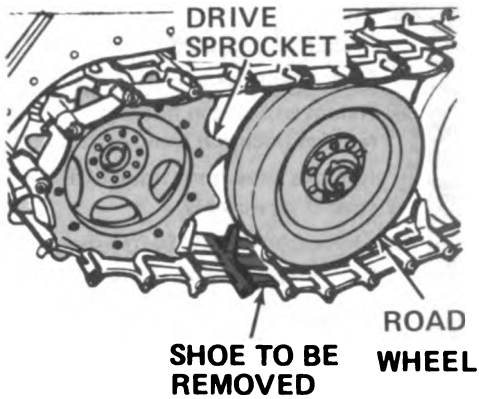
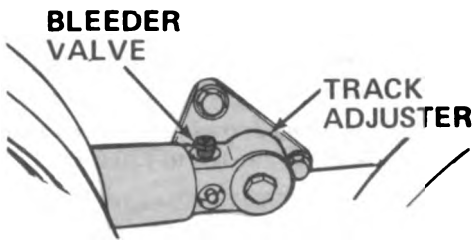
TRACK MAINTENANCE – CONTINUED

DISCONNECTING TRACK

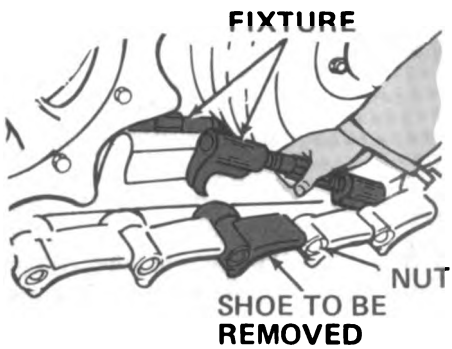
- Drive carrier on level, hard-surfaced ground, and position track shoe to be removed midway between sprocket and first road wheel.
- Block opposite track to prevent movement. Do not lock vehicle brakes.



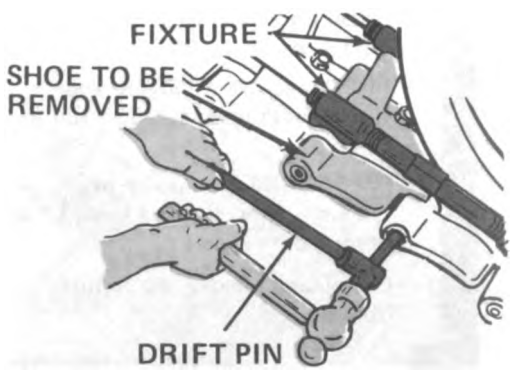
- Turn bleeder valve counterclockwise on track adjuster, and relieve track tension. Turn valve clockwise to close.



- Attach two track connecting fixtures across track shoe to be removed, and tighten fixtures equally to relieve tension on track pin.



- Remove track pin nut from outer end of track pin.
- Start removing track pin, using short leg of drift pin, and remove track pin with long leg of drift pin.
- Loosen and remove two fixtures from track.



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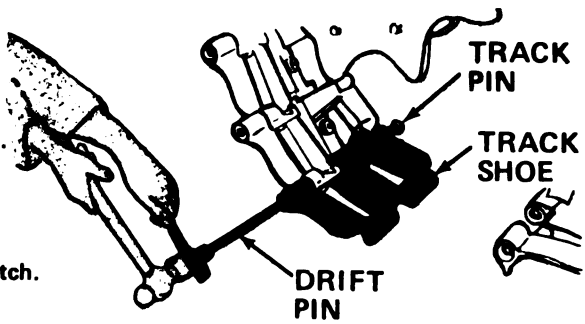
TRACK MAINTENANCE – CONTINUED

REPLACEMENT OF TRACK SHOES

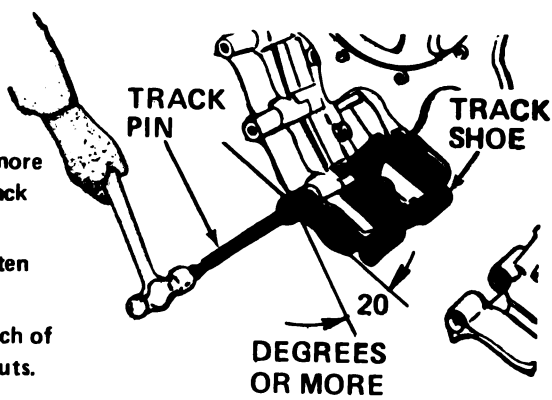
Remove Track Shoe

- Disconnect track (page 3-89).
- Remove track pin nut and remove track pin using drift pin.
- Remove shoe from track and stow if serviceable.
- Check track weekly after shoe is removed because of track stretch.



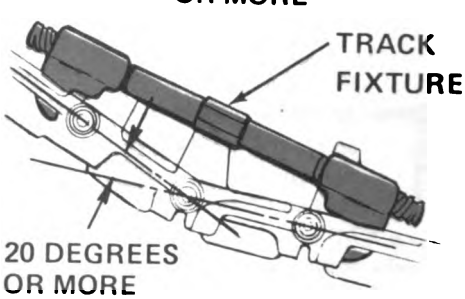
Install Track Shoe

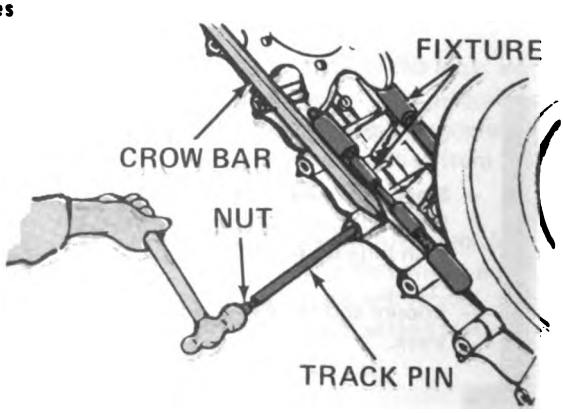
- Coat track pin with corrosion preventive compound, and install nut on one end flush with end of pin.
- Position track shoe on track, align track pin holes with 20 degree or more angle between shoes, and install track pin
- Install inner track pin nut and tighten both nuts to 120 to 130 ft-lb.
- IMPORTANT - minimum of 1/8 inch of thread must extend beyond both nuts.



Connecting Track

- Pull track ends together, and install two track fixtures.
- Coat track pin with corrosion preventive compound and install nut on one end flush with end of pin.
- Align track shoe bushing, tighten track fixtures to obtain 20 degree or more angle between track shoes with track pin holes aligned, and install track pin (use crowbar to obtain correct angle).
- Install inner track pin nut, and tighten both nuts to 120 to 130 ft-lb.
- IMPORTANT - minimum of 1/8 inch of thread must extend beyond both nuts.
- Loosen and remove two fixtures from track.





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TRACK MAINTENANCE – CONTINUED

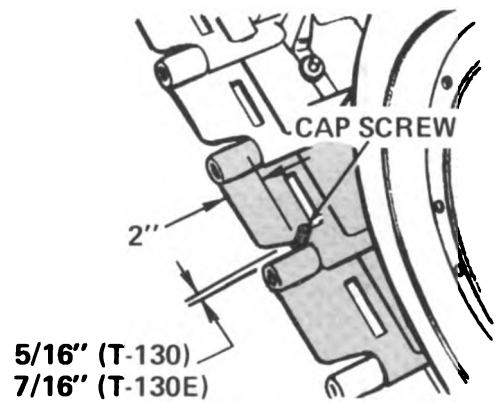
TRACK SHOE WEAR CHECKS

IMPORTANT – Track shoe wear check must be made with track under normal tension. Wear can be measured with track installed on vehicle (track shoes are shown removed for clarity only).

Check that track tension is adjusted correctly (page 3-13).

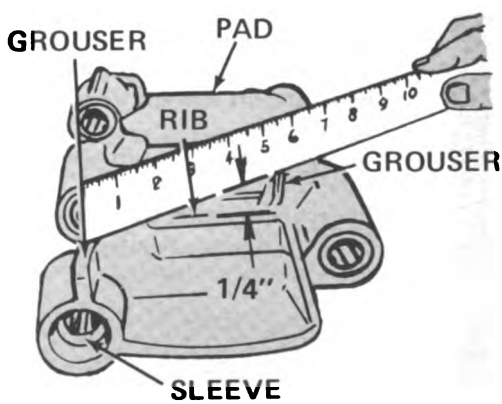
Bushing Wear

- Measure distance between track shoes, 2 inches in from outer edge of shoes. Distance between shoes should be 7/16 inch or less. If distance is more than 7/16 inch, or bushing metal sleeve is 1/16 inch off center of shoe bore, shoe is unserviceable and must be replaced. (A 7/16 inch diameter rod or cap screw may be used to measure bushing wear).



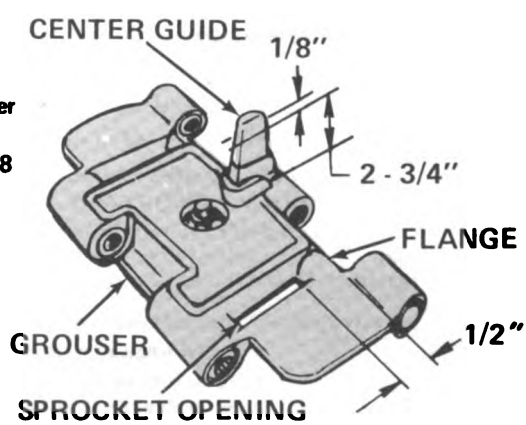
Grouser Wear

- Lay straight edge across raised ribs of grouser on each side of track pad. Measured height of grousers should be 1/4 inch or more.



Center Guide and Flange Wear

- Measure height and thickness of center guide. Height of guide should be 2 - 3/4 inch or more and thickness 1/8 inch or more.
- Thickness of drive sprocket flanges should be 1/2 inch or more.



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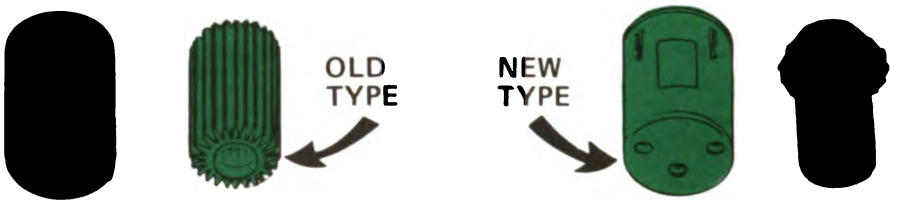
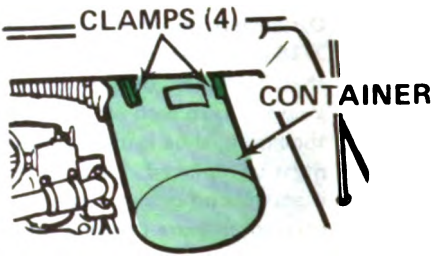
AIR CLEANER

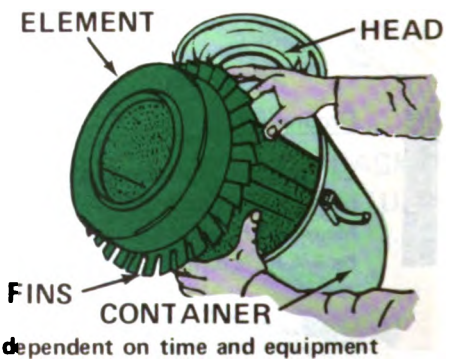


IMPORTANT – There are two types of air cleaners used on this vehicle. Containers and elements are not interchangeable between the two types.



Removing Air Cleaner Containers (new and old types)

Unfasten four clamps securing container to head. Hold container so that it doesn't drop.



Removing and Inspecting Air Cleaner Element

New type (with fins) - Rotate element to unlock it from container and lift element from container.

Old type (no fins) – Lift element from container.

Inspect element for tears, holes, or other damage. Replace if damage affects filtering.

Cleaning Air Cleaner Element (3 methods dependent on time and equipment available)

1. Keep air nozzle from contacting element and direct 100 psi of compressed air against inside of element, then outside of element, then inside of element again. . . . or . . . .
2. CAUTION – Wash element only in soap and water. Rinse thoroughly and dry element completely before reinstalling in container . . . . . or . . . . .
3. Gently tap sides of element with hands so dirt will fall from element. IMPORTANT – Use only hands to tap element and don't hit ends of element.

Installing Element and Container

New type –Place element in container with slots in bottom baffle of element located over stops in container. Rotate element to lock into position. Secure container on air cleaner head with four clamps.

Old type – Place element in container, either end first. Secure container on air cleaner head with four clamps.

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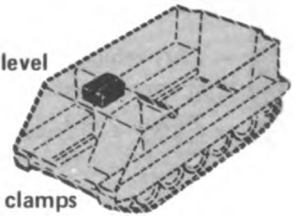
BATTERIES

WARNING

1. DON'T handle ammunition when servicing batteries.
2. DON'T smoke when servicing batteries.
3. DON'T drop any tools across batteries.
4. DON'T wear rings, watches, or bracelets when servicing batteries.

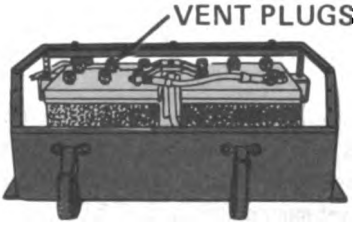
IMPORTANT — Gun system batteries are serviced only by organizational maintenance.

Inspecting Chassis Batteries	Action
- Check for correct electrolyte level	Adjust electrolyte level
- Check for presence of acid on outside of battery	Clean Battery
- Check for loose vent plugs and terminal clamps	Tighten plugs and clamps
- Check for cracked battery cases	Replace battery
- Check for corrosion on terminals, holddown clamps, and battery box	Clean corroded items



Servicing Chassis Batteries

Electrolyte level is normally checked weekly. If, however, ambient temperature is above 100 degrees F, electrolyte level should be checked daily.



Adding Water — Remove vent plugs and add distilled or rain water from non-metallic container to bring electrolyte to split ring level. Reinstall vent plugs.

IMPORTANT — Keep batteries clean and do not overfill. In cold weather charge batteries immediately after adding water so water will combine with electrolyte and not freeze.

Cleaning Chassis Batteries

CAUTION — Do not use wire brush. Wire brush will cause short circuiting and damage to battery cases, vent plugs, or battery terminals.

Tighten vent plugs and clean batteries with a plastic brush dipped in bicarbonate of soda and water. After foaming stops, flush top of battery with clean water and wipe dry with clean cloth. Clean battery terminals, cable terminal clamps, and battery holddown clamps in same manner. Tighten clamps, then coat clamps and terminals with GAA. See TM 9-6140-200-12 for more info.

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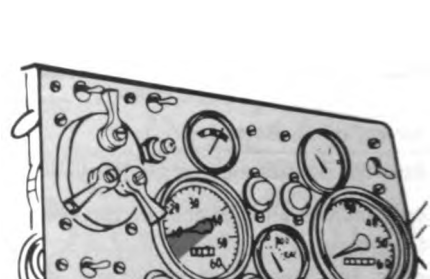
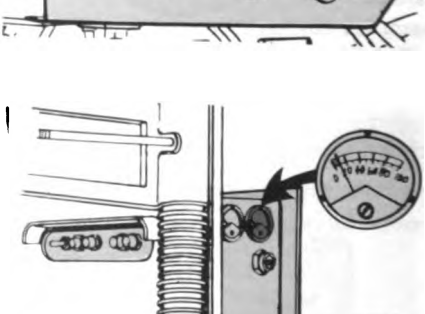
RECHARGING BATTERIES USING VEHICLE ENGINE ALTERNATOR

Gun System Batteries



- Start vehicle engine and set it to run at approximately 1000 rpm (page 2-42 or 2-45).

- Observe AMPS meter on system distribution box for indication that batteries are being charged.

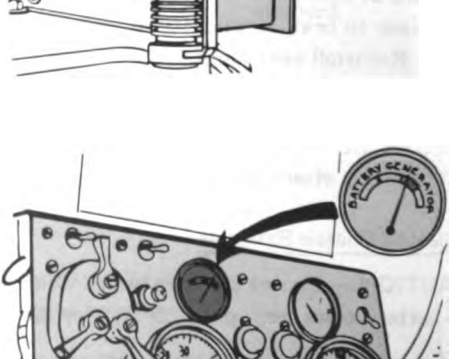


CAUTION

If AMPS meter does not indicate 10 amps or less in 30 minutes, discontinue charging and notify organizational maintenance.

- Continue to operate vehicle engine until AMPS meter indicates 10 amps or less. Gun system batteries are now charged. Stop vehicle engine (page 2-51).

Chassis Batteries



- Start vehicle engine and set it to run at approximately 1000 rpm (page 2-42, or 2-45).

- Continue to operate vehicle engine until BATTERY GENERATOR indicator has indicated in green zone for 2 hours (less time for partially charged batteries). Stop vehicle engine (page 2-51).

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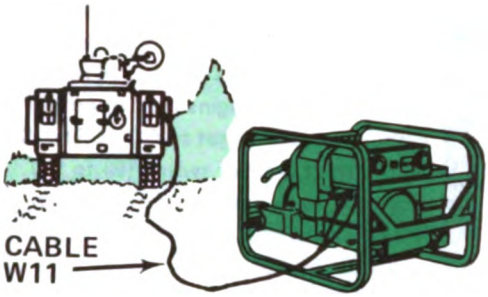
BATTERIES – CONTINUED

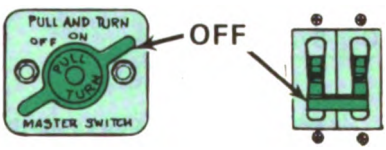
RECHARGING BATTERIES USING AUXILIARY POWER UNIT (APU)



WARNING

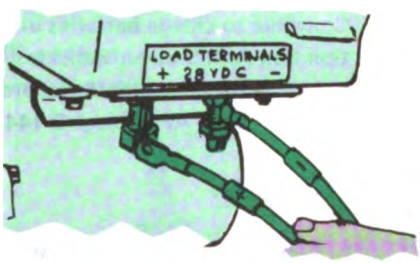
Do not operate APU until you are familiar with operating procedures in TM 5-6115-323-15. The APU produces ample electrical power to cause injury and pain if normal safety precautions are not observed.

IMPORTANT – Vehicle MASTER SWITCH and APU circuit breaker in OFF position before connecting or disconnecting APU power cable.



– **Remove APU from vehicle (page 2-141) for setup and operating instructions.**

– **Connect APU power cable (W11) to LOAD TERMINALS on APU. Make sure that polarity marks on cable match polarity marks at terminals.**



– **Connect other end of APU power cable to APU receptacle. See page 2-142 for inside and outside APU receptacle locations.**

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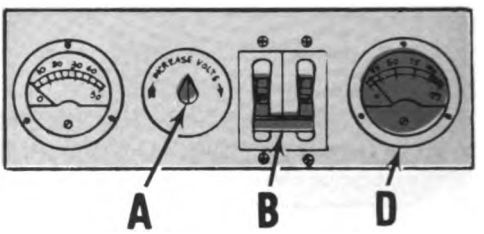
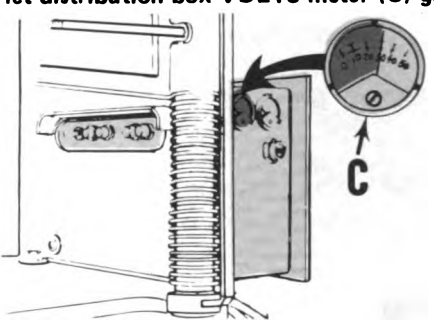
BATTERIES – CONTINUED

Set APU variable resistor knob (A) to vertical. Set APU circuit breaker switch (B) to OFF. Start APU (page 2-141). Don't apply load until engine runs smoothly with carburetor control set to GOVERN. Set APU circuit breaker switch (B) to ON. Adjust variable resistor knob (A) until VOLTS meter (C) on distribution box indicates 28 - 29 volts.



IMPORTANT – During charging process, don't let distribution box VOLTS meter (C) go over 29 volts.

NOTE: – If load current meter (D) is over 100%, APU circuit breaker (B) may trip due to overload. If this happens, reset circuit breaker and adjust variable resistor knob (A) to decrease reading on VOLTS meter (C) to start charging. Continue to monitor VOLTS meter (C) and adjust APU output (29 volts max.) during charging process.

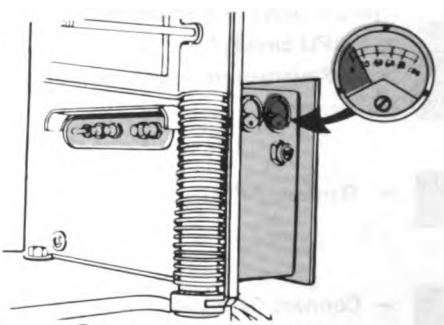


Gun System

CAUTION

If AMPS meter does not indicate 10 amps or less in 30 minutes, discontinue charging and notify organizational maintenance.

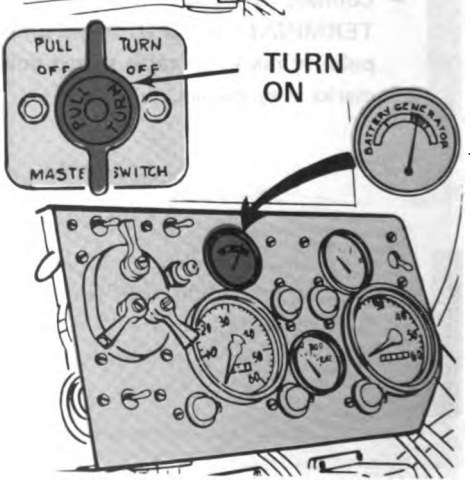
Continue to charge batteries until distribution box AMPS meter indicates 10 amps or less. Gun system batteries are now charged. Stop APU (page 2-144).



Chassis Batteries

Turn MASTER SWITCH to ON. Continue to charge batteries until BATTERY GENERATOR indicator has indicated in green zone for 2 hours (less time for partially charged batteries).

Chassis batteries are now charged. Turn MASTER SWITCH to OFF. Stop APU (page 2-144).



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M168 CANNON

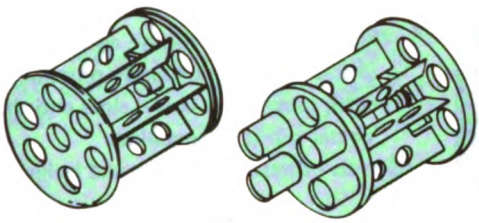
Cleaning.

- Barrels - Use cleaning staff and bore brush saturated in lubricating oil (PL-M).
- Exterior surfaces - Wipe clean and apply light coat of PL-M.

Inspection.

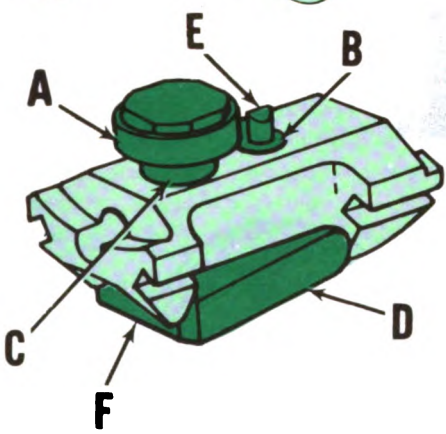
Muzzle clamps

- Check for deformation, broken welds, damaged lugs or damaged threads on clamp lock.



Breech bolts

- Check roller (A) on bolt shaft for free movement, flats and gouges.
- Check visible portion of firing pin cam insulation (B) for cracks.
- Check bolt shaft (C) for grooves, nicks, burrs, and cracks.
- Check bolt shaft, locking block (D), and firing pin cam (E) for freedom of movement. Check locking surface (F) for scoring or damage.
- Check for proper lubrication (LO 9-2350-300-10).

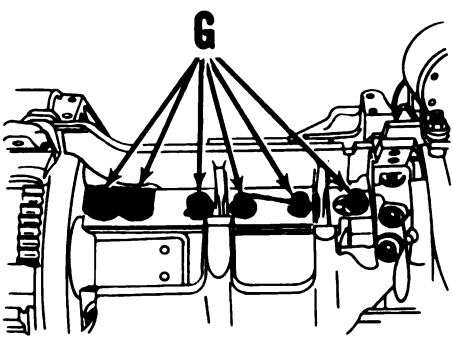


Rotor

CAUTION

Don't hold BRAKE-CLEAR AND BRAKE switch in CLEAR AND BRAKE position longer than 10 seconds during any 1-minute interval.

- Remove case chute
- Hold switch in CLEAR AND BRAKE position.
- Rotate cannon in firing direction and check that safety wiring on track bolts and screws (G) is undamaged.
- After check, install case chute.



NOTE: Feeder shown removed for clarity.

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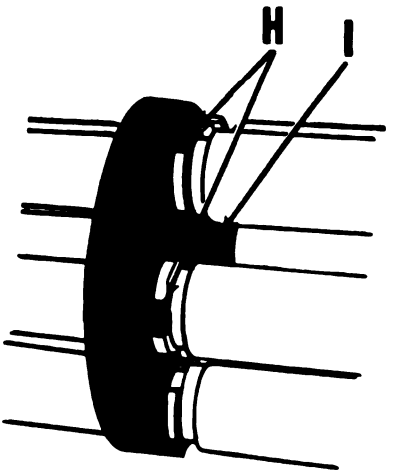
M168 CANNON – CONTINUED

Center barrel clamp

- Check for deformation and cracks.
- Assure clamp is properly positioned with tabs (H) in barrel slots and that cotter pin (I) is installed.

Barrels - Check for cracks and bulges.



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Removal of muzzle clamps (air defense and ground role)

– Set control assembly GUN POWER switch to OFF.

WARNING

Clear cannon. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE and rotate cannon barrels two complete revolutions.

CAUTION

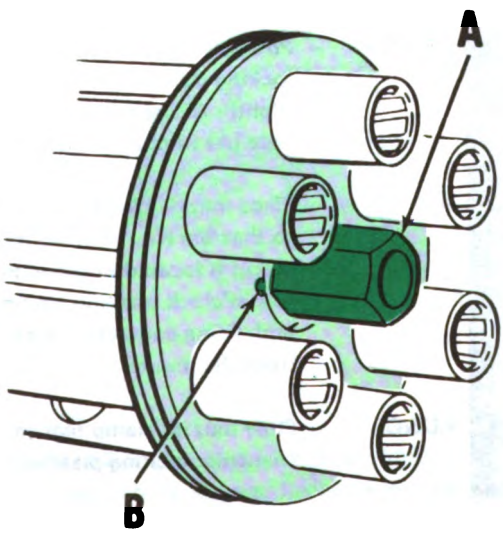
Don't hold switch in CLEAR AND BRAKE position longer than 10 seconds during any 1 minute interval.

IMPORTANT – Don't use timing pin to lock barrel cluster while loosening muzzle clamp bolt.

– Loosen muzzle clamp locking bolt (A) and disengage locating pin on triangular locking plate from hole (B) in front plate.

– Rotate locking plate counter-clockwise (seen from muzzle) until it is free of barrels and remove muzzle clamp. If necessary, a soft faced hammer may be used to drive muzzle clamp off barrels

– See page 3-4 for cleaning and inspection instructions.



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M168 CANNON – CONTINUED

Installation of air defense (AD) and ground role (G) muzzle clamps.

AD&G – Set control assembly GUN POWER switch to OFF.

WARNING

Clear cannon. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE and rotate cannon barrels two complete revolutions.

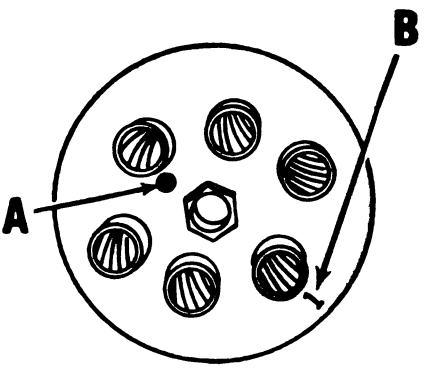
CAUTION

Don't hold switch in CLEAR AND BRAKE position longer than 10 seconds during any 1 minute interval.

AD – Time cannon. Hold BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE position. Depress cannon timing pin and rotate cannon until timing pin engages. Release CLEAR AND BRAKE switch and timing pin. Check that timing pin is disengaged.

AD&G – Position muzzle clamp triangular locking plate so that pin is slightly to right of locating hole (A) in muzzle clamp.

AD – Place muzzle clamp on barrels so that the No. 1 (B) on muzzle clamp is located at barrel in the four o'clock position (in line with firing contact) as viewed from the muzzle.



AD&G – Slide muzzle clamp rearward until it hits a positive stop. Assure that triangular locking plate engages rear sides of barrel flanges.

AD&G – Rotate muzzle clamp triangular locking plate clockwise (relative to muzzle end) until pin on locking plate is aligned with locating hole in front plate of muzzle clamp.

IMPORTANT – Don't use timing pin to lock barrel cluster while tightening muzzle clamp bolt.

AD&G – Torque muzzle clamp bolt to 600 - 650 in-lb.

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Breech bolt removal

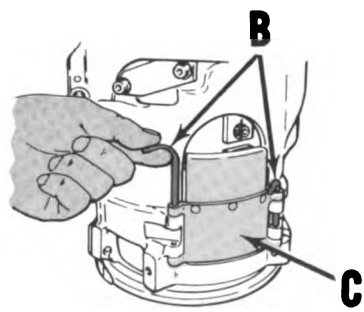
WARNING

Make sure the cannon is clear before performing the following procedure.

- **Remove two front quick release pins and release two rear latches (A) on gun shield. Remove gun shield, then elevate cannon to maximum elevation.**

- **Set control assembly SYSTEM POWER and GUN POWER switches to OFF.**

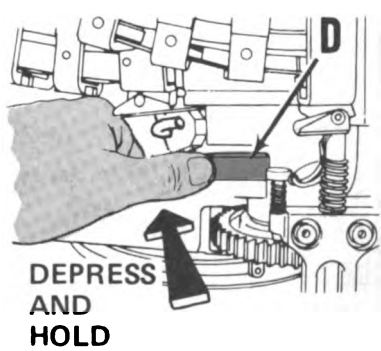
- **Pull two bolt access cover pins (B) and remove bolt access cover (C).**



CAUTION

Don't hold BRAKE-CLEAR AND BRAKE switch in CLEAR AND BRAKE position longer than 10 seconds during any 1 minute interval.

- **Have a second man depress and hold clearing cam sector (D) on cannon, and set BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE on your command.**



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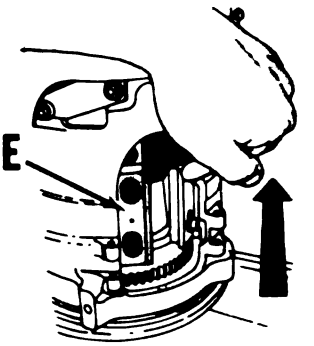
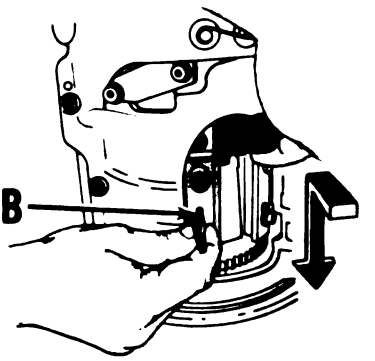
M168 CANNON – CONTINUED

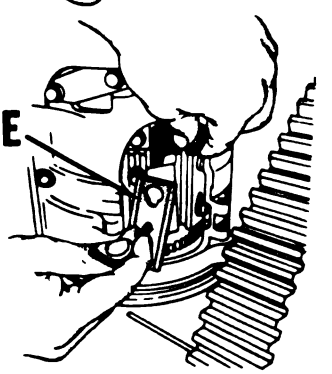
– Rotate cannon until bolt is in cover area, release BRAKE-CLEAR AND BRAKE switch, then move bolt forward to clear removable track (E).



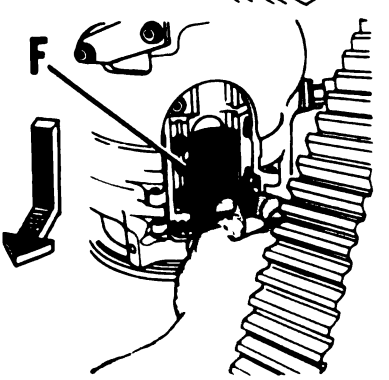
– Use bolt access cover pin (B) to depress track lock pin and release removable track.



– Move track (E) to rear and out.



– Slide bolt (F) to rear and lift out.



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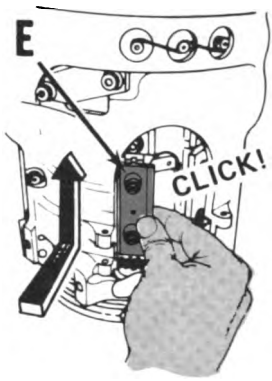
M168 CANNON – CONTINUED

- Replace removable track (E) with large diameter hole toward muzzle of cannon, and slide track forward until locking pin snaps into place.



- Remove five remaining bolts in the same manner without replacing tracks.
- Leave last track on rotor after last bolt is removed.
- See page 3-97 for cleaning and inspection instructions.

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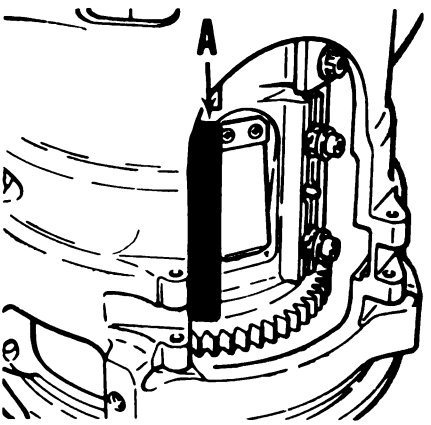
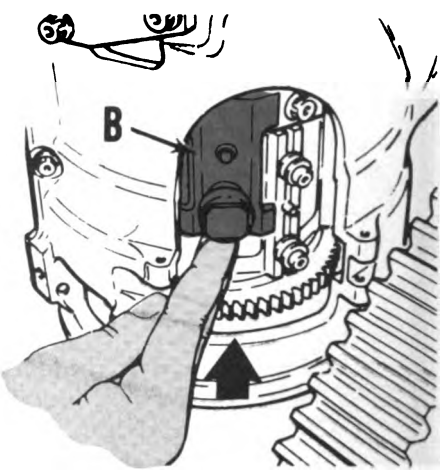
Breech bolt installation

CAUTION – Don't hold BRAKE-CLEAR AND BRAKE switch in CLEAR AND BRAKE position longer than 10 seconds during any 1 minute interval.

– Set switch to CLEAR AND BRAKE and rotate cannon to locate track (A) left on the rotor during removal procedure, and position as shown in the cover area. Release switch.



– Install bolt (B) on track and move bolt forward.



– Install next removable track (C).

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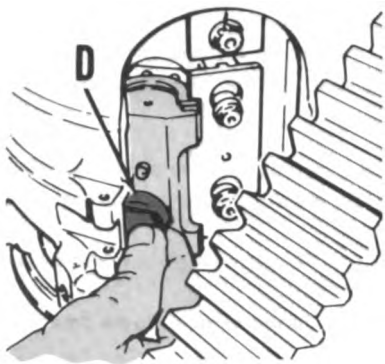
M168 CANNON – CONTINUED

NOTE – Have a second man set BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE position on your command.

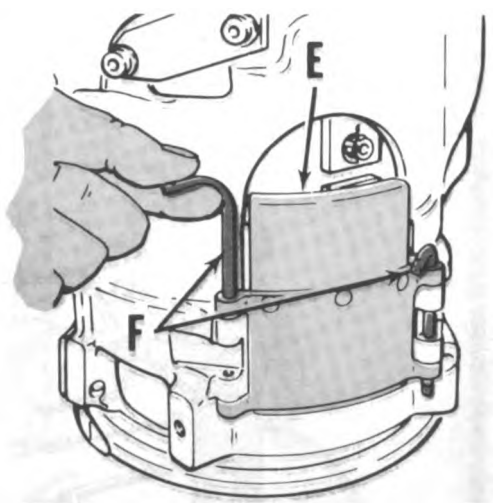
– Push in on bolt roller shaft (D), set switch to CLEAR AND BRAKE position, and rotate cannon until rotor is in position to install next bolt and track. Release switch.



– Install remaining bolts in the same manner.

– After installation of fifth bolt, rotate cannon to position for installation of sixth bolt. Remove next track, install sixth bolt, and reinstall track.

– Install bolt access cover (E) and secure with pins (F).



– Lower cannon and install gun shield.

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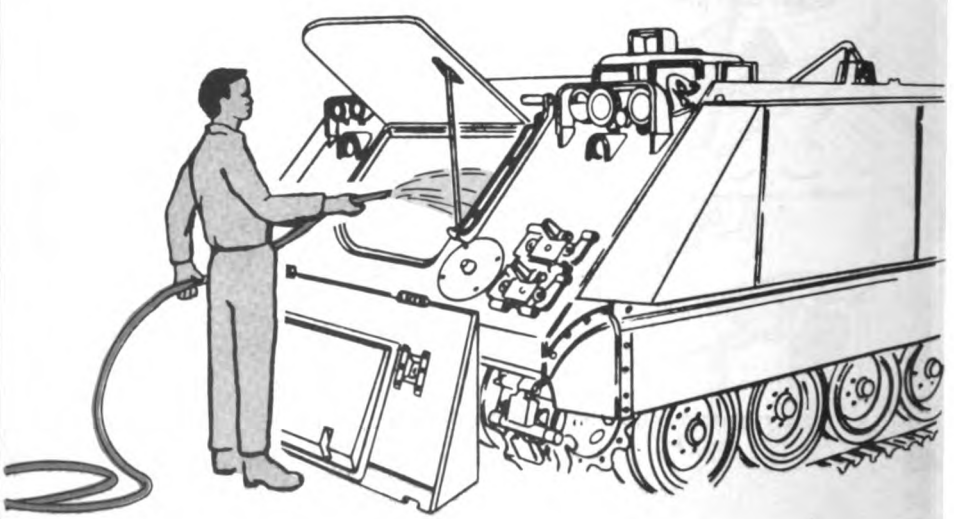
AFTER WATER OPERATION MAINTENANCE

IMPORTANT – If vehicle was submerged or the interior flooded, it should go to organizational maintenance as soon as possible, regardless of temporary measures taken. Organizational maintenance will: 1) If water or sludge is present in drained lubricants, flush with proper lubricant and refill, 2) Disassemble, clean and repack all road wheel, idler wheel, and support arm bearings that have grease fittings, 3) Lubricate per LO 9-2350-300-10.

As soon as possible after routine water operation drain, flush and clean hull with low pressure water as follows:

- Remove front hull and final drive drain plugs (page 2-59).
- Slope vehicle down and slightly to the right.
- Drop trim vane and open engine access door and flush all components in engine compartment with clean fresh water.
  IMPORTANT – Don't saturate electrical components.
- Slope vehicle down and left slightly.
- Flush final drive and hull plates. Inspect recess to insure all water is drained.
- Service front bilge pump (page 3-107).



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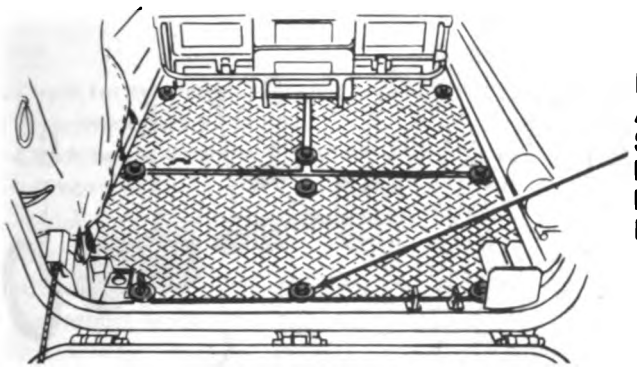
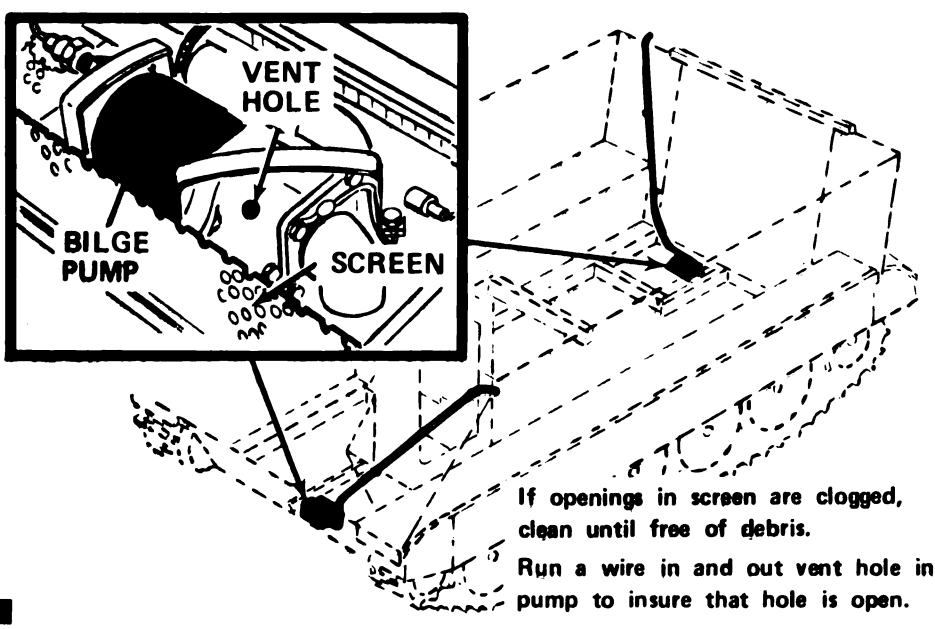
AFTER WATER OPERATION MAINTENANCE – CONTINUED



- Elevate front of vehicle. Remove rear hull drain plug, and drain water.
- Lower ramp, remove personnel compartment floor plates (3) and flush hull bottom plates with low pressure water.
- Service rear bilge pump (see below).
- Install floor plate and all hull and final drive drain plugs. Close engine compartment access door and retract trim vane.
- Lubricate all areas in contact with water per LO 9-2350-300-10.

BILGE PUMPS



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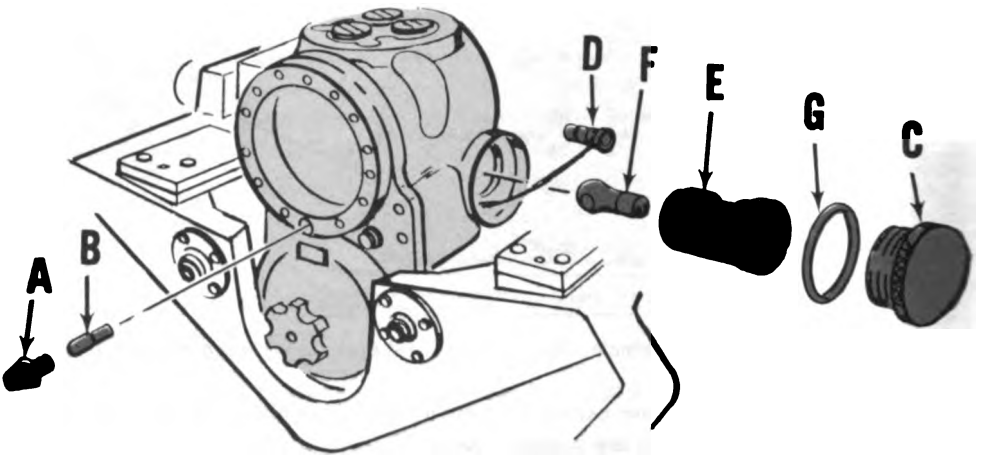
M61 SIGHT AND AZIMUTH INDICATOR



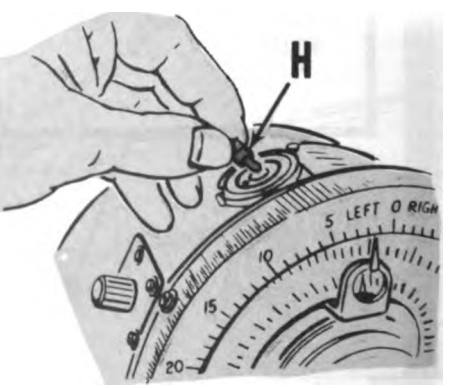
LAMP REPLACEMENT

Ready to fire lamp - Unscrew red lense cover (A) and remove lamp (B).

Reticle lamp -

- Unscrew reticle lamp cover (C).
- Unplug connector (D) and remove reticle lamp holder (E) by pulling straight out.
- IMPORTANT - Don't touch clear portion of lamp with bare hands. Replace reticle lamp (F), making sure that clear portion of bulb will face the gunner when holder is installed.
- To install reticle lamp holder in sight housing, align guide pin in housing with notch in top of holder, and push holder straight in until seated.
- Plug connector (D) into reticle lamp holder (E).
- Check that "0" ring gasket (G) is in place in cover (C) and install cover.

Azimuth indicator lamps (4) - unscrew lamp (H) and replace.



CLEANING

All glass surfaces on the sight should be cleaned with cotton and water. Dry cleaning solvent or mineral spirits paint thinner may be used to clean grease and oil from unpainted metal parts.

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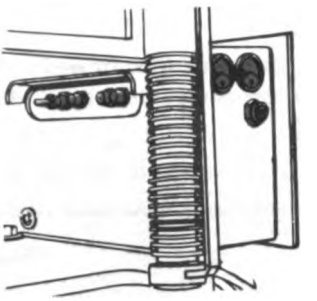
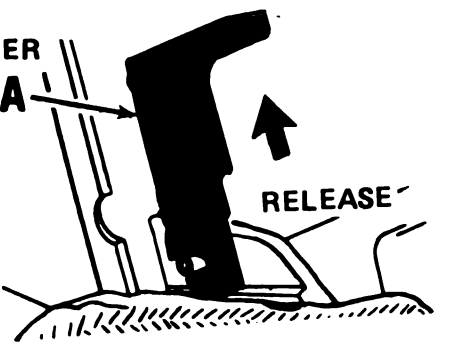
DISTRIBUTION BOX



Inspection

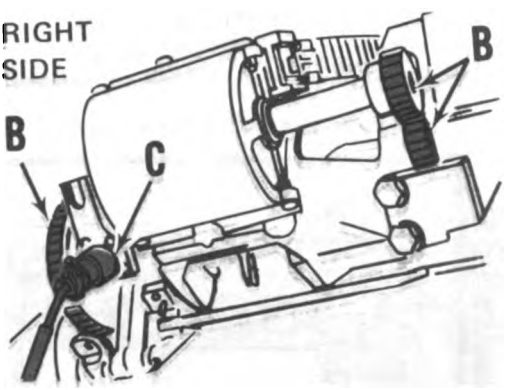
- Check for cracked or broken glass on ammeter and voltmeter.
- Check box and connectors for security of mounting.
- Check for tripped or damaged circuit breakers.
- Check NORM-STATIC-TEST switch for proper operation.

DECLUTCHING FEEDER

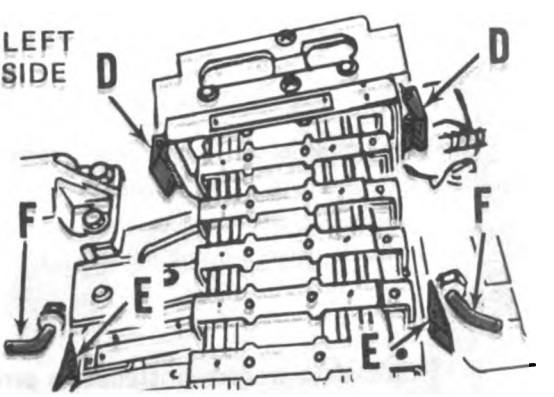


Inspection

- Remove two front quick release pins and release two rear latches (A) on gun shield. Remove gun shield. Check latches for damage or looseness.



- Check all visible gears (B) for burrs, nicks, or missing teeth.
- Disconnect cable (C) and check plug and receptacle for corrosion, alignment, and cracked inserts.
- Check cable for abraded insulation and reconnect cable.



- Check return chute (D) and feed chute (E) clips for serviceability.
- Check for broken safety wire on feeder mounting pins (F).
- Install gun shield.

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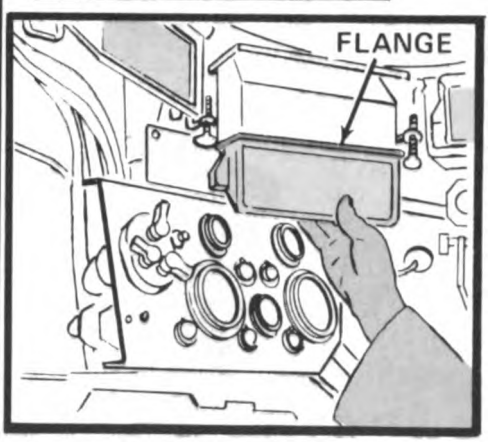
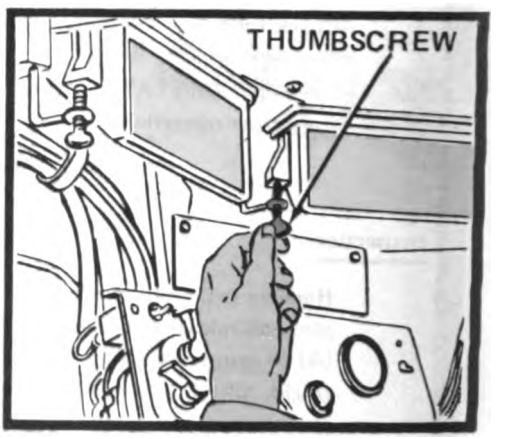
M17 PERISCOPE INSTALLATION/REPLACEMENT

A spare periscope, stowed on left wall behind driver, can be used to replace any one of four periscopes mounted around driver's hatch.

Left, right, and front periscopes.

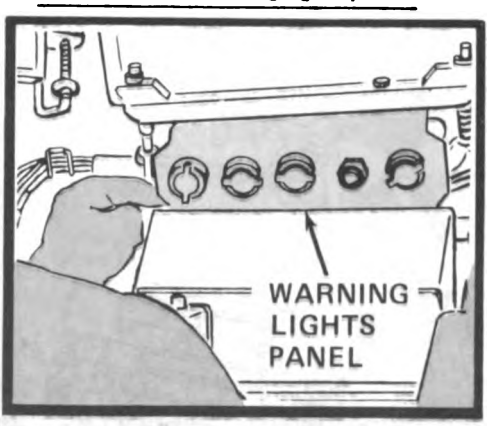


- **Swing thumbscrew clamps aside.**
- **Insert periscope through porthole.**
- **Make sure flange is inside vehicle.**

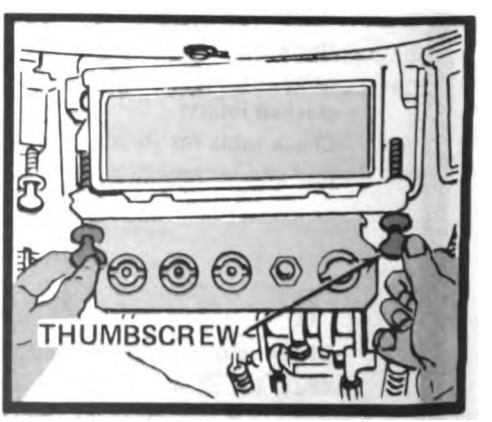


- **Position thumbscrew clamps and tighten.**

Periscope over warning lights panel.



- Push warning lights panel forward.
- Insert periscope through porthole.
- Make sure flange is inside vehicle.



- **Swing warning lights panel under periscope and tighten thumbscrew clamps.**
- **Install cover on periscope.**

REMOVAL (reverse installation procedures)

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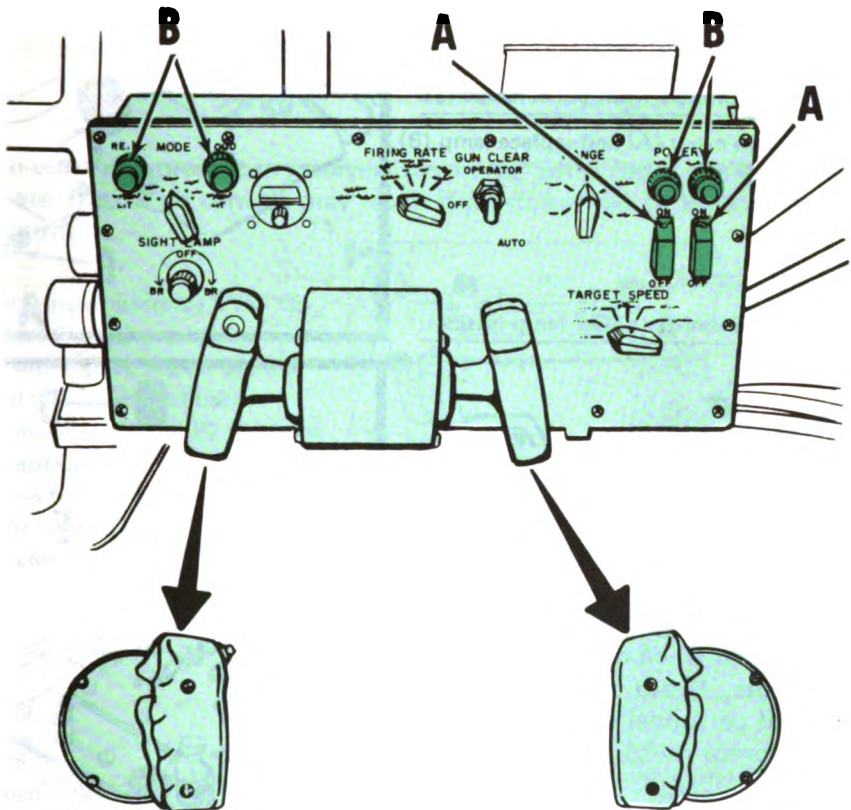
CONTROL ASSEMBLY

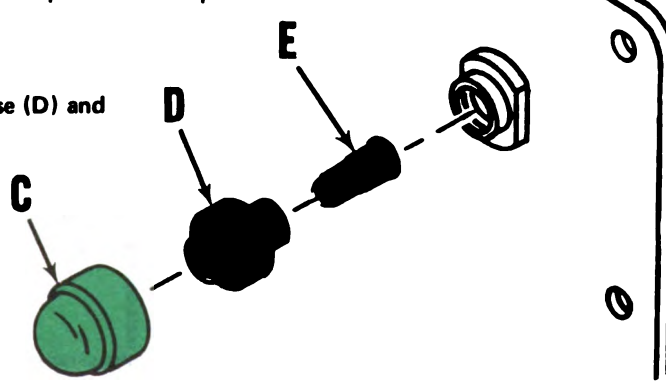


Inspection.

- Check all switches for free movement and smoothness of operation.
- Check for chipped or flaking paint.
- Check markings for legibility.
- Check that guards (A) pivot smoothly over switches.

Cleaning. Dry cleaning solvent or mineral spirits paint thinner may be used to clean grease and oil from unpainted metal parts.

Lamp (B) replacement.
Unscrew cover (C), lense (D) and replace lamp (E).



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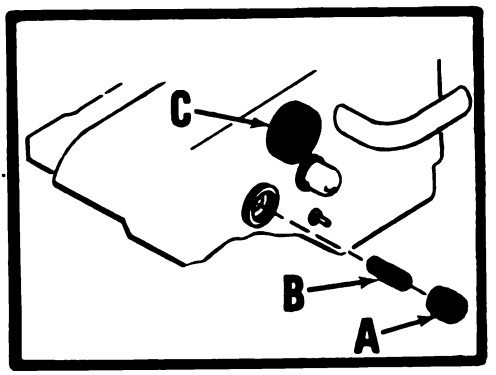
RECEIVER-TRANSMITTER AND RF POWER LAMPS

LAMP REPLACEMENT

Receiver-transmitter front panel lamps (2).

Unscrew lens cover (A) and replace lamp (B).

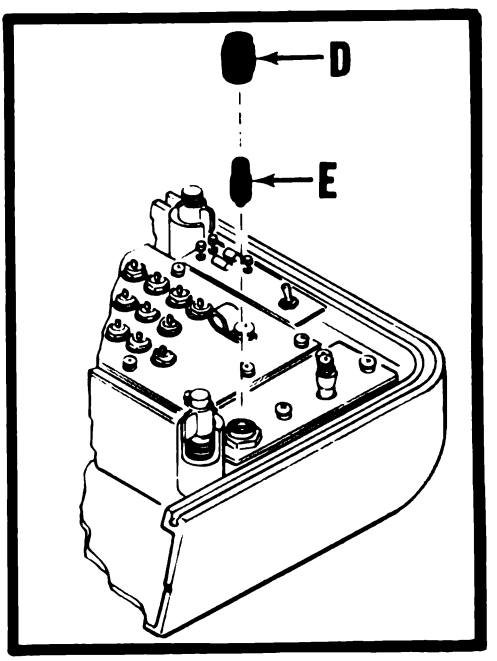


Receiver-transmitter power lamp (inside).

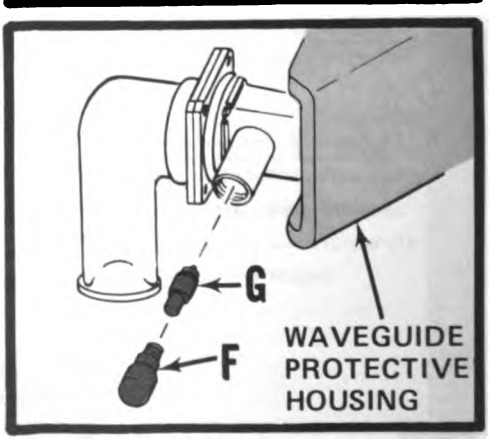
WARNING

High voltage is present in receiver-transmitter when radar is energized to radiate. Death on contact may result if personnel fail to observe safety precautions.

- Set control assembly SYSTEM POWER switch to OFF.
- Open front panel by turning four thumbscrews (C) counter-clockwise.
- Unscrew lens (D) and replace lamp (E).
- Close front panel and secure with thumbscrews.



RF power indicator lamp. Unscrew lens (F) and replace lamp (G).



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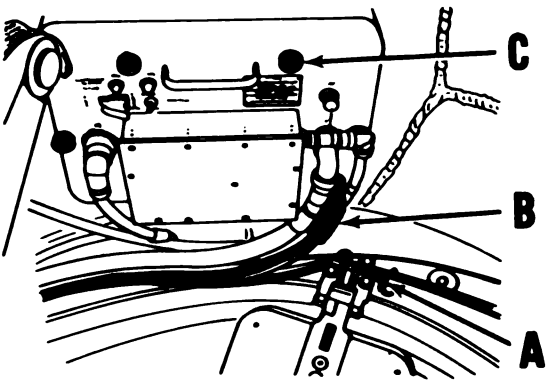
RECEIVER-TRANSMITTER AIR FILTER

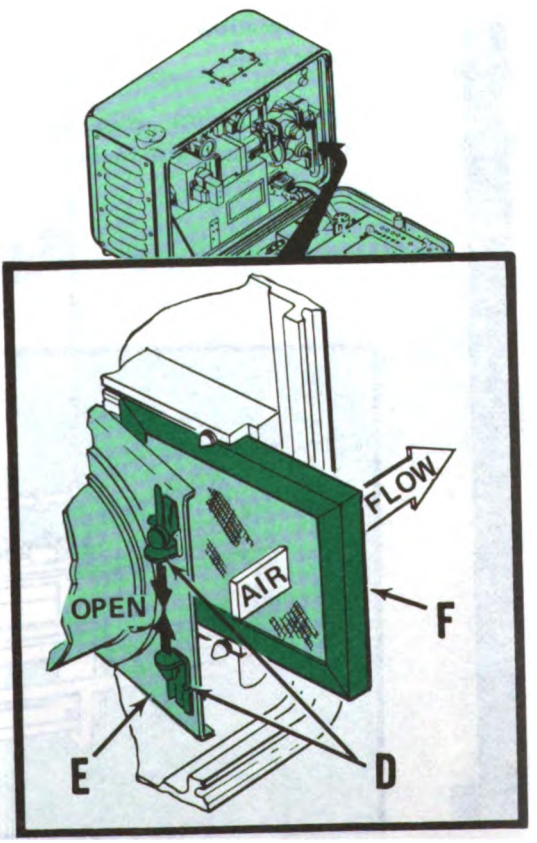
Removal and Cleaning.

WARNING

High voltage is present in receiver-transmitter when radar is energized to radiate. Death on contact may result if personnel fail to observe safety precautions.



- Set control assembly SYSTEM POWER switch to OFF.
- Remove quick release pin (A) and fold down seat back.
- Remove connector P2 (B) from receptacle J5.
- Open front panel by turning four thumbscrews (C) counter-clockwise.



- Open scissor clips (D) and cover (E).
- Remove filter (F).
- Wash air filter in clear water or a solution of water and mild detergent. Hold filter vertically and dip in water to clean. Rinse thoroughly and dry completely before reinstalling.
- Install air filter, observing air-flow arrow direction on filter frame.
- Close cover and engage upper and lower scissor clips.
- Close front panel and secure with thumbscrews.
- Install connector P2 on receptacle J5.

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POWER SUPPLY AIR FILTER

Removal and Cleaning.

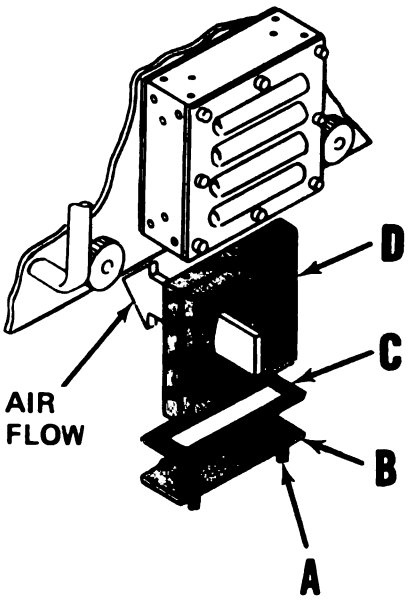
—Turn four captive screws (A) counterclockwise to remove access plate (B) and gasket (C).

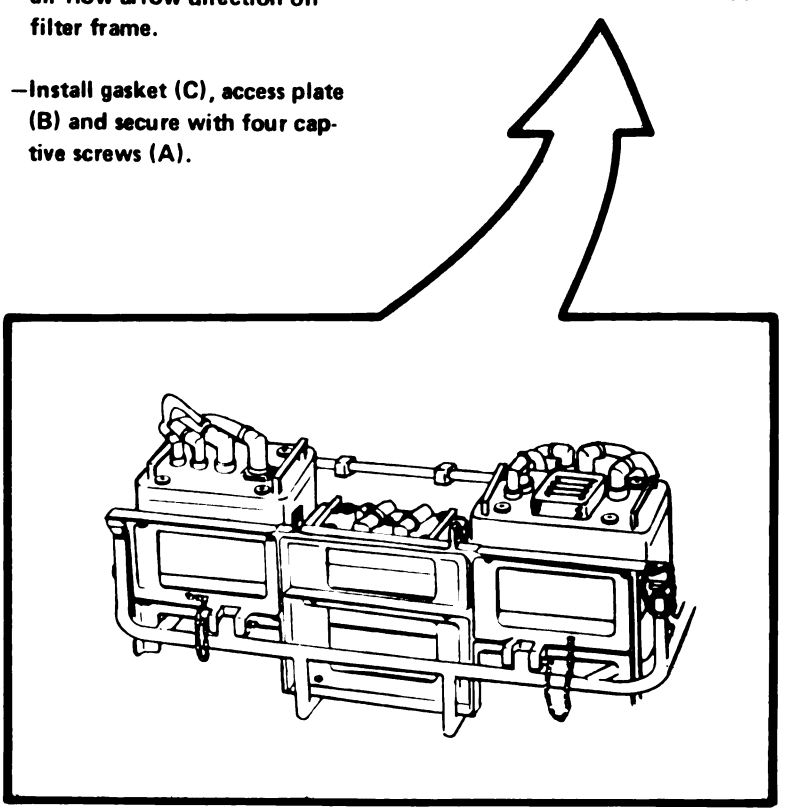
—Remove filter (D) by pushing filter gently, using a screwdriver through louvers.

—Wash air filter in clear water or a solution of water and mild detergent. Hold filter vertically and dip in water to clean. Rinse thoroughly and dry completely before reinstalling.

—Install air filter (D), observing air flow arrow direction on filter frame.

—Install gasket (C), access plate (B) and secure with four captive screws (A).





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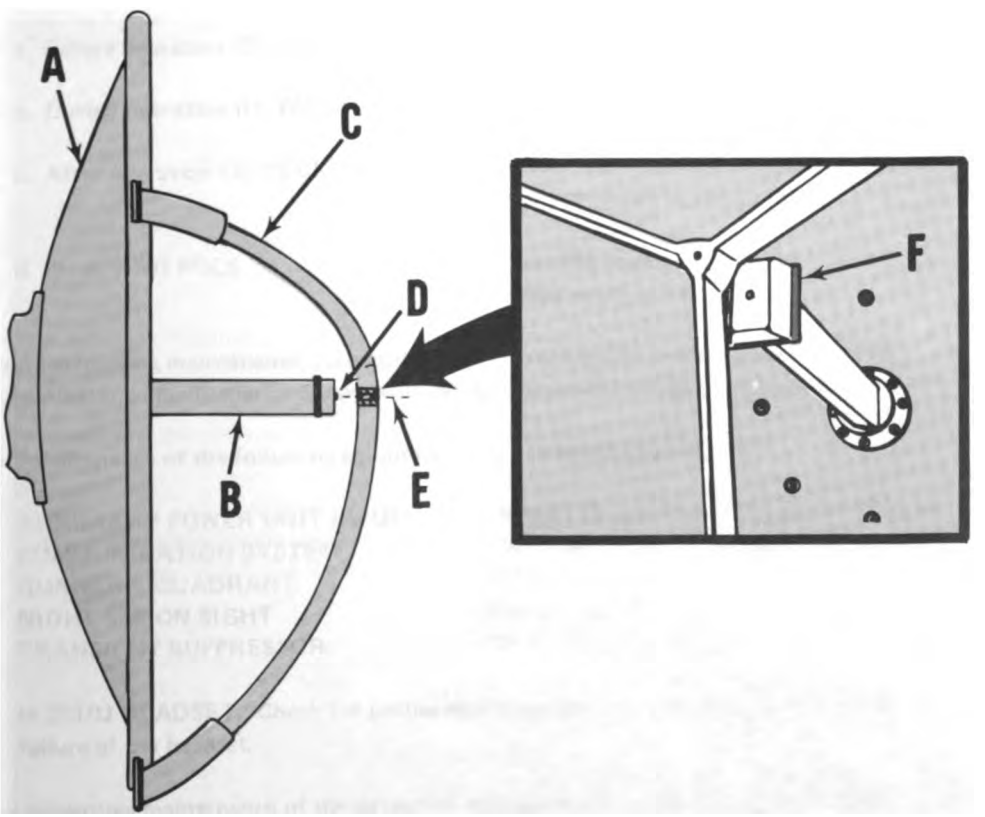
ANTENNA REFLECTOR AND FEED ASSEMBLY

Inspection. **(Notify organizational maintenance if defect is found during inspection).**

- **Check reflector (A) for dents, bends, or holes. Check for distortion of reflector parabolic shape.**
- **Check that feedhorn (B) and reflector are attached securely.**
- **Check that feedhorn protection brackets (C) are attached securely to reflector. Check for any distortion of protective brackets.**
- **Visually check alignment of feedhorn to reflector. White dot (D) on feedhorn is centered in hole of protective brackets. Be sure line-of-sight is centered in hole (E) when making check. Check for two windows (F) behind feedhorn. If white dot or windows are missing, notify organizational maintenance.**



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CHAPTER 4
MAINTENANCE OF AUXILIARY EQUIPMENT

4-1. Introduction. This chapter contains preventive and corrective maintenance procedures for equipment used in connection with your system. The instructions that follow are the responsibility of the crew.

Section I. AUXILIARY EQUIPMENT PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-2. At the specified interval, perform the applicable PMCS as listed in table 4-1. This should be performed in conjunction with PMCS table 3-1.

a. Before operation (B) PMCS	— Insures system ready for operation.
b. During operation (D) PMCS	— Detects unsatisfactory performance.
c. After operation (A) PMCS	— Reveals any damage or unsatisfactory condition resulting from operation.
d. Weekly (W) PMCS	— Preventive maintenance actions performed every week.

4-3. When performing maintenance, record any maintenance action according to TM 38-750. Notify organizational maintenance of any malfunctions beyond your scope to correct.

4-4. For maintenance of the following equipment, refer to applicable TM.

AUXILIARY POWER UNIT (APU)	—TM 5-6115-323-15 and TM 5-2805-208-14
COMMUNICATION SYSTEM	—TM 11-5830-340-12 and TM 11-5820-401-12
GUNNER'S QUADRANT	—TM 9-1290-200-14
NIGHT VISION SIGHT	—TM 11-5855-202-13
TRANSIENT SUPPRESSOR	—TM 11-5915-224-14

H-251/U HEADSET. Check for proper operation and any damage that may cause failure of the headset.

4-5. For preventive maintenance of the personnel compartment heater, the engine coolant heater, the turn signal kit, the arm/safe switch, and the driver's windshield, use table 4-1.

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Table 4-1. Auxiliary Equipment Preventive Maintenance Checks and Services

10 min.	8 min.	4 min.	
B – BEFORE OPERATION	D – DURING OPERATION	A – AFTER OPERATION	W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				PERSONNEL COMPARTMENT HEATER (page 2-132)
1				Electrical System. Check circuit to heater by depressing control box PERSONNEL HEATER indicator. Lamp should light.
		16		Personnel Heater. Check that heater indicator lamp remains lit and blower continues to run after stopping heater, until heater is purged.
				WARNING Do not turn off vehicle MASTER SWITCH until heater has been turned off, has purged itself, and blower has stopped.
2		17		Fuel System. Check exposed fuel lines and connections for leaks. Before operation, open fuel shutoff cock. After operation, close fuel shutoff cock.
3	12			Personnel Heater. Start and run heater. Indicator on control box should light when heater starts and remain lit when heater is running. Observe heater operation and quantity of exhaust smoke. Report unusual conditions to organizational maintenance.
				NOTE If ignition is delayed, exhaust may be smoky immediately after ignition, but should clear after a few minutes of operation.
4	13	18		Intake, exhaust, and duct outlets. Check heater air intake, exhaust outlet, and warm air duct outlets for obstructions. Openings should be free of any restrictions.
				DRIVER'S WINDSHIELD (page 2-130)
5		19		Check for worn or torn fabric and strap assembly, scratched or cracked window, and broken or bent clips and supports. Make sure windshield is properly secured or stowed.

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Table 4-1. Auxiliary Equipment Preventive Maintenance Checks and Services – Continued

B – BEFORE OPERATION | D – DURING OPERATION | A – AFTER OPERATION | W – WEEKLY

INTERVAL AND SEQUENCE NO.				ITEM TO BE INSPECTED
B	D	A	W	PROCEDURE
				ENGINE COOLANT HEATER (page 2-134)
6				Electrical System. Check circuit to heater with MASTER SWITCH on by depressing control box HEATER CONTROL indicator. Indicator lamp should light.
		20		Coolant Heater. Check that heater indicator lamp remains lit and blower continues to run after stopping until heater is purged.
				WARNING Do not turn off vehicle MASTER SWITCH until heater has been turned off, has purged itself, and blower has stopped.
7		21		Fuel System. Check fuel lines and connections for leaks. Before operation, open shutoff cock. After operation, close shutoff cock.
8	14			Coolant Heater. Start and run coolant heater. Indicator lamp should light after heater starts and remain lit when heater is running.
	15			Battery Box. Check to see that box is properly closed and batteries do not overheat.
9		22		Coolant Circulating System. Check coolant hoses and connections for leaks. Before operation, open coolant shutoff cocks (one between engine and transmission and one on coolant heater). After operation, close coolant shutoff cocks.
				TURN SIGNAL KIT (page 2-11)
10				Lights. Check operation of lights (if tactical situation permits) in all three operating positions.
		23		Reflectors. Inspect for cracked, missing, or broken glass.
				ARM–SAFE SWITCH (page 2-29)
11		24		Switch, cable, and connector. Check cable for kinks, and cut or abraded insulation. Check connector for bent pins. Check for free operation of switch.

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Section II.
TROUBLESHOOTING AUXILIARY EQUIPMENT

4-6. This section provides information useful in troubleshooting auxiliary equipment. Notify organizational maintenance of any problems for which no corrective action is given. Table 4-2 lists malfunctions, tests or inspections, and corrective actions which the crew can perform. Checks and inspections should be made in the order given.

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Table 4-2. Troubleshooting Auxiliary Equipment

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
NOTE: For corrective action of any malfunction not listed in this table, notify organizational maintenance.		
1. PERSONNEL COMPARTMENT HEATER		
(1) Heater fails to start with RUN-OFF-START switch held in START position.		
	Check that MASTER SWITCH is in ON position.	Turn MASTER SWITCH to ON position.
	Check that fuel shutoff cock is open.	Open fuel shutoff cock.
(2) Heater overheats and stops burning.		
	Check for restricted air circulating system.	Clear restrictions from air inlet, exhaust outlet, and duct outlets as necessary.
(3) Heater overheats and continues to burn.		
	None.	Turn fuel shutoff cock off and notify organizational maintenance.
(4) Heater output too low.		
	Check that HI-LO switch is in HI position.	Set switch to HI position.
(5) Heater smokes excessively or "Bangs" when starting.		
	None.	Stop heater by turning fuel shutoff cock off, and notify organizational maintenance.
	NOTE: If ignition is delayed, the exhaust may be smoky immediately after ignition, but should clear after a few minutes.	

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Table 4-2. Troubleshooting Auxiliary Equipment - Continued

MALFUNCTION / TEST OR INSPECTION	CORRECTIVE ACTION
1. Personnel Compartment Heater (Continued)	
(6) Heater blower does not stop after RUN-OFF-START switch is placed in OFF position.	
None. NOTE: Heater will continue to run a minute or so until purged of fuel under normal conditions.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
(7) Odor of fuel in air circulating system.	
None.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
(8) Heater blower runs, but heater fails to ignite.	
Check that fuel shutoff cock is open.	Open fuel shutoff cock.
2. ENGINE COOLANT HEATER	
(1) Heater fails to start when RUN-OFF-START switch is is in START position.	
Check that MASTER SWITCH is in ON position.	Turn MASTER SWITCH to ON position.
Check that fuel shutoff cock is open.	Open fuel shutoff cock.
(2) Heater blower runs when RUN-OFF-START switch is in START position but heater does not ignite.	
Check that fuel shutoff cock is open.	Open fuel shutoff cock.

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Table 4-2. Troubleshooting Auxiliary Equipment - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Engine Coolant Heater (Continued)		
(3) Heater blower runs when RUN-OFF-START switch is in START position and heater ignites, but indicator does not light.	Check for defective indicator lamp.	Notify organizational maintenance.
(4) Heater starts and runs but goes out later.	Check that fuel shutoff cock is open.	Open fuel shutoff cock.
	Check that coolant shutoff cocks are open.	Open shutoff cocks on engine and at heater.
(5) Heater overheats.	Check that coolant shutoff cocks are open.	Open shutoff cock on engine and at heater. If heater still overheats, stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
(6) Heater output low.	Check that HI-LO switch is in HI position.	Set switch to HI position.
(7) Heater smokes excessively.	None. NOTE: If ignition is delayed, exhaust may be smoky immediately after ignition, but should clear up after a few minutes of operation.	Stop heater by turning fuel shutoff cock off, and notify organizational maintenance.

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Table 4-2. Troubleshooting Auxiliary Equipment - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Engine Coolant Heater (Continued)		
(8) Heater blower does not stop after RUN-OFF-START switch is in OFF position.	None. NOTE: Heater will continue to run a minute or so until purged of fuel under normal conditions.	Stop heater, turn fuel shutoff cock off, and notify organizational maintenance.
(9) Vehicle batteries overheat during heater operation.	Check that air temperature is −25°F or below.	Heater operation not required above −25°F. Turn off heater.
3. TURN SIGNAL KIT		
(1) Lights do not flash with control lever in operating position.	Check that MASTER SWITCH is in ON position.	Turn MASTER SWITCH to ON position.
	Check that driving selector switch is in STOP or SER DRIVE position.	Position driving light selector switch to STOP or SER DRIVE position.
	Check for defective signal control, flasher, or electrical circuit.	Notify organizational maintenance.
(2) Front turn signal light or rear stoplight-taillight does not flash with control lever in operating position.	Check for defective lamps or electrical circuits.	Notify organizational maintenance.

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CHAPTER 5
AMMUNITION

Section I. GENERAL

5-1. General. This chapter contains a description of 20MM ammunition intended for use with the cannon. National stock numbers and pertinent data for the standard ammunition are listed in SC-1305/30 IL.

WARNING

Rechambering of live ammunition is prohibited. The use of previously chambered cartridges may result in damage to equipment or injury to personnel due to cartridge hangfire. Propellant primer contamination, a cause of hangfire, can occur because the chambering action may loosen the projectile in the cartridge case and break the waterproof seal. Any cartridges that have been chambered and later extracted unfired will be disposed of in accordance with TM 9-1300-206 and/or local regulations.

5-2. Description and Identification. The ammunition is painted and color coded to provide a ready means of identification. Caliber, type, model, and lot number are marked on the projectiles. The following table shows the types and color codes. The ammunition types are further described following the table.

Table 5-1. Types and Color Codes of Ammunition

Key Fig.	Kind of ammunition	Color of projectile	Color of marking
1	HEIT-SD M246 (high explosive incendiary tracer-self destruct)	Yellow w/brown and red bands	"T" in red, rest of markings black
2	HEI, M56A3 (high-explosive incendiary)	Yellow w/red bend	Black
3	TP-T, M220 (target practice-tracer)	Blue	"T" in orange, rest of markings in white
4	TP, M55A2 (target practice)	Blue	White
	Dummy, M51A2	Chromate	Metal Stamping

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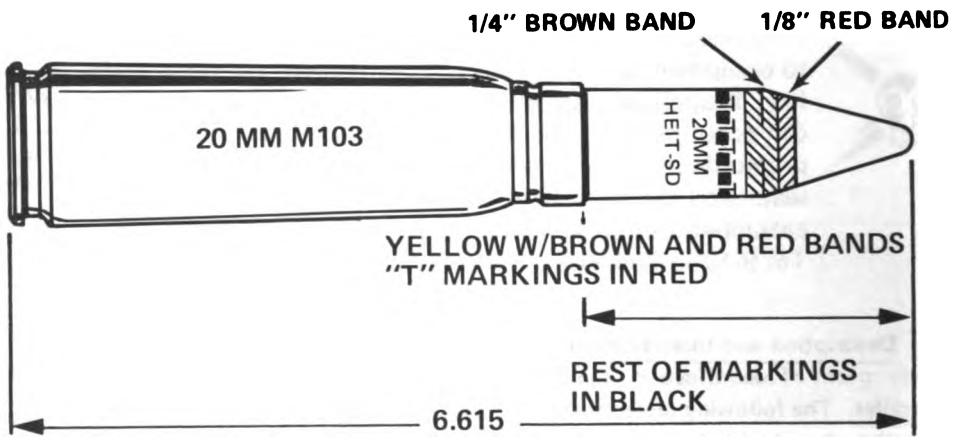
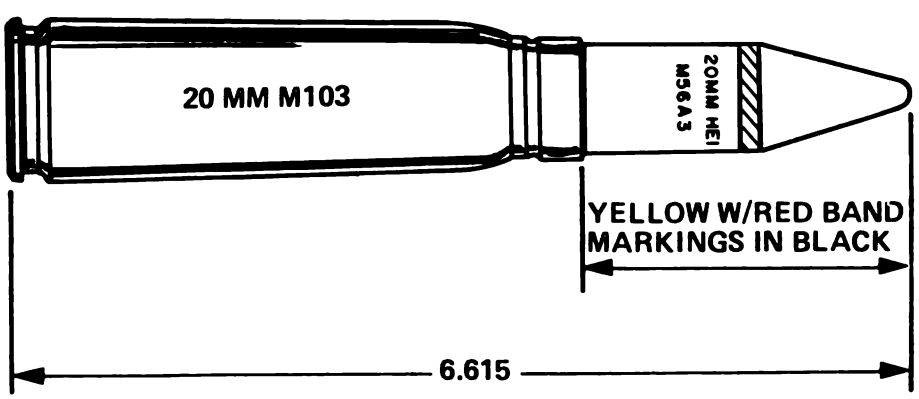
AMMUNITION – CONTINUED

DESCRIPTION AND IDENTIFICATION

1 High-Explosive Incendiary With Tracer Self-destroying (HEIT-SD), M246. This cartridge is assembled with an M505A3 point detonating (PD) fuze. The projectile, in addition to the M505A3 fuze, consists of an HEI charge, self-destruct relay charge, and a tracer charge. These charges form the self-destruct chain. The tracer burns for about 3 to 7 seconds, whereupon the relay charge is ignited which detonates the HEI charge low order. If impact with a target occurs, prior to self-destruction, the M505A3 fuze causes the HEI charge to detonate high order. This cartridge is for use against aerial targets.



2 High-Explosive Incendiary (HEI), M56A3. This cartridge is for use against ground targets, including lightly armored vehicles, functioning with both explosive and incendiary effect. The projectile consists of an HEI charge and is assembled with the M505A3 fuze. The M505A3 fuze is a point-detonating, single-action fuze intended to function on impact with the target.



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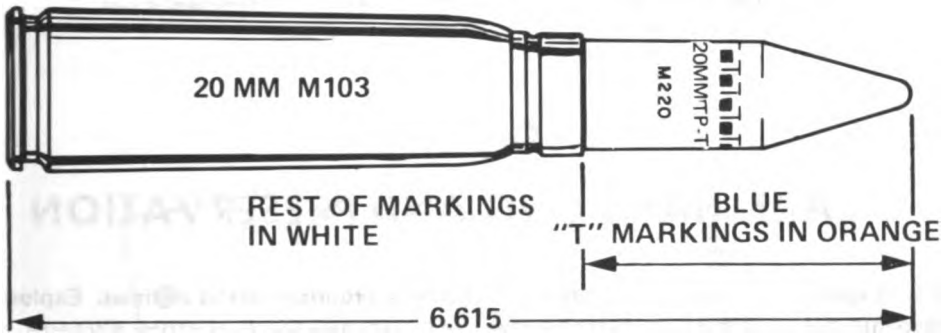
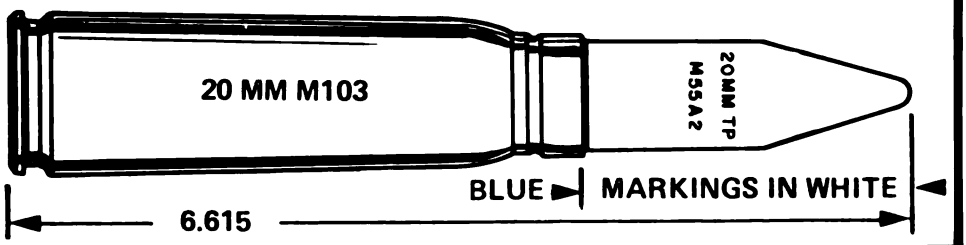
AMMUNITION – CONTINUED

DESCRIPTION AND IDENTIFICATION–CONTINUED

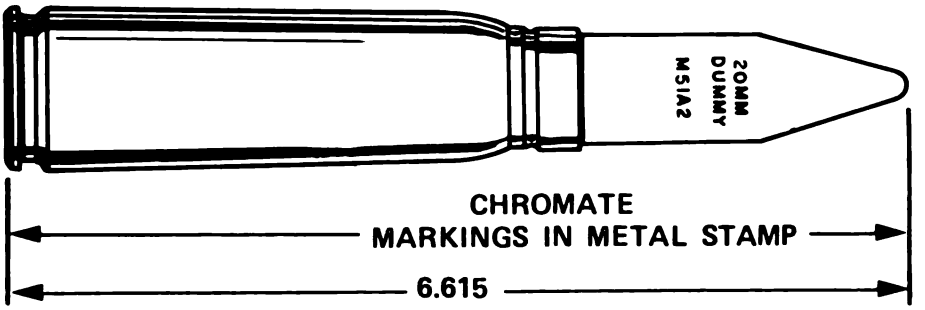
3 Target Practice - Tracer (TP-T), M220. This cartridge is for practice and training. The projectile is similar to the M56A3 projectile, but has no HEI charge and is assembled with a dummy fuze. The projectile does contain a tracer composition which burns visibly for a minimum of 1.9 seconds.



4 Target Practice (TP), M55A2. This cartridge is for practice and test firing. The projectile is similar to the M56A3 projectile, but is hollow and contains no HEI charge or tracer.



5 Dummy, M51A2. The dummy is a completely inert assembly used for filling the conveyor system during shipment or storage and for nonfiring system checkout.



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Section II.

PREPARATION FOR FIRING

5-3. Ammunition will be visually inspected to assure that it is clean, free of grease and corrosion, and that it is free of perforations, cracks and splits, severe scratches, cuts and dents other than those caused by normal delinking and relinking operation.

Section III.

CARE, HANDLING AND PRESERVATION

5-4. Explosive ammunition must be handled with appropriate care at all times. Explosive elements such as primers and fuzes are sensitive to excessive shock, electrical discharge, and temperature. Keep ammunition in a serviceable condition and ready for immediate use as follows:

(1) Store ammunition in original containers in a dry, well-ventilated place protected from rays of sun and other sources of excessive heat.

(2) Keep ammunition and its container clean and dry and protected from possible damage.

(3) Disassembly of components of ammunition, such as fuzes and primers, is strictly prohibited. Any alteration of ammunition is hazardous and shall not be undertaken. Re-linking of ammunition is permitted.

(4) Do not open sealed ammunition containers or remove protective or safety devices until just before use.

(5) Return ammunition, prepared for firing but not fired, to its original packing and mark it appropriately. Use such ammunition first in subsequent firings in order to keep stocks of opened packages at a minimum.

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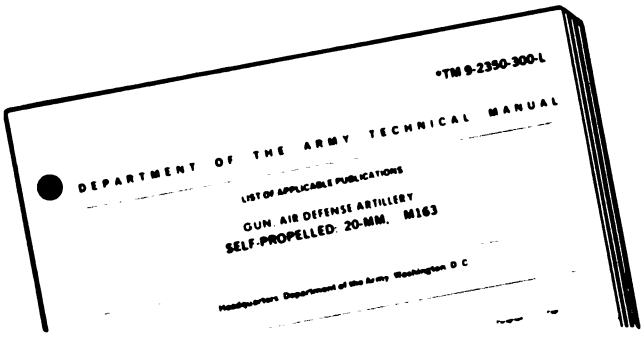
APPENDIX A
PUBLICATION REFERENCES


*TM 9-2350-300-L

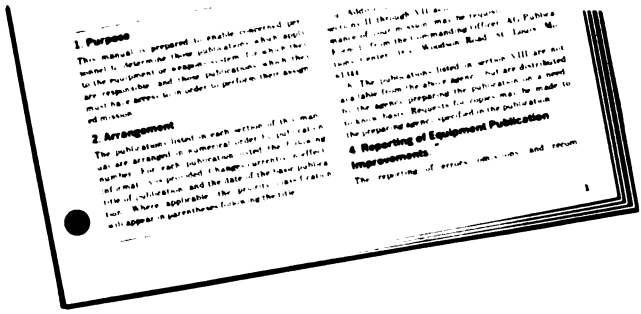
DEPARTMENT OF THE ARMY TECHNICAL MANUAL

LIST OF APPLICABLE PUBLICATIONS

GUN, AIR DEFENSE ARTILLERY
SELF-PROPELLED: 20-MM, M163

Headquarters, Department of the Army, Washington, D.C.

A COMPLETE LIST OF CURRENT REFERENCES, INCLUDING SUPPLY MANUALS, TECHNICAL MANUALS AND OTHER AVAILABLE PUBLICATIONS REQUIRED TO PERFORM YOUR MISSION CAN BE FOUND IN TM 9-2350-300-L. MAKE SURE YOU USE A CURRENT LISTING IF YOU ORDER ADDITIONAL COPIES OF PUBLICATIONS.


1. Purpose

2. Arrangement

4. Reporting of Equipment Publication Improvements

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APPENDIX B
BASIC ISSUE ITEMS AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Section I. INTRODUCTION

B-1. This appendix lists basic issue items and items troop installed or authorized required by the crew to operate and maintain the M163.

B-2. Basic Issue Items List – Section II. A list, in alphabetical sequence, of items which are furnished with, and which must be turned in with the end item.

B-3. Items Troop Installed or Authorized List – Section III. A list, in alphabetical sequence, of items which, at the discretion of the unit commander, may accompany the end item, but are not subject to be turned in with the end item.

B-4. Explanation of Columns. The following provides an explanation of columns in the tabular listings.

a. National Stock Number. Indicates the national stock number assigned to the item and will ba used for requisitioning purposes.

b. Description. Indicates the federal item name and a minimum description required to identify the item. The last line indicates the reference number followed by applicable Federal Supply Code for Manufacturer (FSCM) in parentheses.

c. Figure Number (Sect II only). This column indicates the number used to reference the item and illustration. Locations are also given.

d. Quantity Authorized (Sect III only). Indicates the quantity of the item authorized to be used with the equipment.

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Section II. BASIC ISSUE ITEMS LIST

1 ADAPTER, SOCKET WRENCH,
male to female, 3/4 sq. male end,
1/2 sq. female end, TB2
GGG-W-641 Type IV, class 5, style A
(81348)

5120-00-144-5207

In Vehicle Tool Bag

2 ADAPTER, SOCKET WRENCH
male to female, 3/8 sq. male end, 1/2
sq. female end, TB2
GGG-W-641 Type IV, class 5, style A
(81398)

5120-00-240-8702

In Vehicle Tool Bag

3 BAG, PAMPHLET, canvas
7961712 (97384)

2540-00-670-2459

Behind Driver
on Left Side

4 BINDER, LOOSE LEAF, 3 ring, for
log book
3052216-3 (92392)

7510-00-889-3494

In Pamphlet Bag

5 CABLE ASSEMBLY, electrical,
branched W11
8437142 (19204)

1005-00-936-5387

In APU Frame

6 CABLE, TOW, steel 3/4 dia. 10 ft lg
w/2 eyes
10861718 (19207)

4010-00-767-3149

On Ramp
Outside Vehicle

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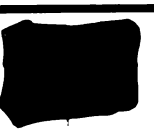
BASIC ISSUE ITEMS LIST – CONTINUED

7 CARTRIDGE, DUMMY, 20MM
M51A2, 1 BELT
100 CTG/MTL box
11075758 (19201)

1305-00-157-4616

8 CASE, AMMO, carrying, canvas
w/sling (4)
7052438 (81349)

8465-00-705-2438



(1) Turret
(1) Left of Driver
(2) Shelf Above APU

9 CASE, CARRYING
10553971 (19200)

1240-00-782-9652

On stowage
tray above APU

10 CLAMP ASSEMBLY, MUZZLE,
(ground mode) 5-mil circular
dispersion.
11010336 (19204)

1005-00-754-5291

In tray above
batteries

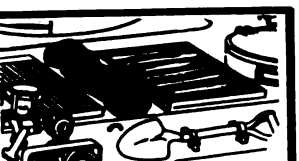
11 COVER, ANTENNA
8437624 (19204)

1005-00-888-3999

In turret
bin

12 COVER, GRILLE, ENGINE
10865823 (19207)

2400-00-767-3147



On Deck
between Grilles

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BASIC ISSUE ITEMS LIST – CONTINUED

13 COVER, PERISCOPE (4)
10866115 (19207)

2590-00-898-6771

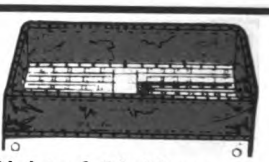
On Periscopes

14 COVER, TURRET
8437623 (19204)

1005-00-226-2663

In Turret Bin

15 CURTAIN, AIR GRILLE,
10950064 (19207)



2540-00-923-4250

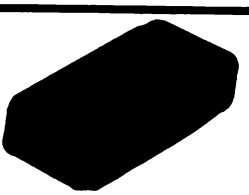
Right of Air Vent
in Crew Compartment

16 EXTINGUISHER, FIRE,
CARBON DIOXIDE
MIL-E-468, type 1, class 1,
(81349)

4210-00-270-4512

Under APU

17 FIRST AID KIT, GENERAL
PURPOSE
57-K-340-12 (80244)



6545-00-922-1200

At Left of Driver's Seat

18 FIXTURE, TRACK
CONNECTING (2)
10932359 (19207)

5120-00-073-9736

On Top Deck, Left Rear

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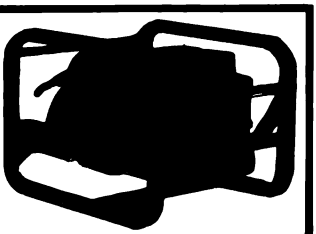
BASIC ISSUE ITEMS LIST – CONTINUED

19 GENERATOR SET, GASOLINE ENGINE, (APU)
13213E2700 (97403)

6115-00-017-8236

At Right Rear in Vehicle



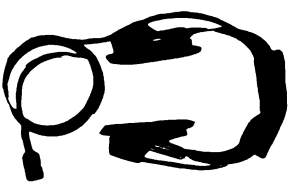
20 LUBRICATING GUN, HAND, hi pressure, lever operated 15 oz
MIL-G-3859 (81349)

4930-00-253-2478

In Vehicle Tool Bag

21 HEADSET
H-251/U (81134)

5965-00-043-3460



22 KIT ASSEMBLY, BORESIGHT
10545540 (19200)

4931-00-997-4568

In Stowage Tray Above APU

23 LINKER-DELINKER, M25, 20MM, hand
7790853 (19204)

4925-00-787-9803

In Armament Tool Bag

24 LINK, LOADING, LEAD (6)
8437138 (19204)

1005-00-936-5385

In Armament Tool Bag

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BASIC ISSUE ITEMS LIST – CONTINUED

25 LINK, LOADING, TAIL (6)
8437139 (19204)

1005-00-936-5386

In Armament Tool Bag

26 MITTEN, CLOTH, ASBESTOS (2)
MIL-M-1119 (81349)

8415-00-266-8843

In Armament Tool Bag

27 PADLOCK, w/clevis and chain,
2 keys (2)
MS35647-3 (96906)

5340-00-682-1508

On Drivers Hatch
and Gun Travel Lock

28 PIN, DRIFT, track pin removal
10861180 (19207)

5120-00-678-2795

In Vehicle Tool Bag

29 POST, CURTAIN (5)
10950078 (19207)

2540-00-923-4249

In Air Grille Curtain Pocket

30 QUADRANT, GUNNER'S,
M1A1 w/case, carrying
7197156 (19200)

1920-00-891-9999

On Shield Bracket
Left of Gunner

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BASIC ISSUE ITEMS LIST—CONTINUED

31 RANGE CONTROL ASSEMBLY, EXTERNAL
10545548 (19200)

1920-00-997-4569

On Right Rear Wall Behind APU

32 SCREWDRIVER, flat tip, CB416-6 (11728)

5120-00-010-7915

In Vehicle Tool Bag

33 STRAP, webbing, w/buckle and end clip, 1w, 48 lg (10)
8690477 (19207)

5340-00-753-3745

In Oddment Bin

34 STRAP, webbing, w/buckle and end clip, 1-½w, 18 lg
8690513 (19207)

5340-00-827-8483

Outside Rear Tow Cable Stowage

35 STRAP, webbing, w/buckle and end clip, 1-½ w, 30 lg
8690519 (19207)

5340-00-753-3743

Outside Rear Tow Cable Stowage

36 STRAP, webbing, w/buckle and end clip, 1-½ w, 54 lg (2)
8690527 (19207)

2540-00-968-4060

Outside Rear Reel Stowage

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BASIC ISSUE ITEMS LIST – CONTINUED

37 STRAP, webbing, w/buckle and end clip, 1-½ w, 72 lg (4)
8690532 (19204)

1025-00-965-7833

Outside Rear Can Stowage

38 SWITCH ASSEMBLY, SAFE, SHORT
8437361 (19204)

1005-00-824-4485

In Stowage Tray Above APU

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Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

National Stock Number	Description	Qty Auth
4930-00-288-1511	ADAPTER, GREASE GUN MIL-L-4387 (81349)	1
5110-00-293-2336	AXE, single bit GGG-A-926 (81348)	1
1005-00-305-0256	BAG, LINK DISPOSAL 8437522 (19204)	1
5140-00-473-6256	BAG, TOOL, SATCHEL 6518760 (18876)	1
1005-00-610-8828	BRUSH, CLEANING, SMALL ARMS 6108828 (19206)	1
1005-00-722-5087	BRUSH, CLEANING, SMALL ARMS 7225087 (19204)	4
7240-00-222-3088	CAN, GASOLINE, MILITARY MIL-C-1283 (81349)	1
7240-00-242-6153	CAN, WATER, MILITARY 64C281 (80244)	2
5140-00-261-4994	CARRIER, TOOL GGG-C-1520 (81348)	1
1290-00-809-1379	CASE, PLASTIC, w/insert 10557496 (19200)	1
7910-00-526-1959	CLEANER, VACUUM, ELECTRIC WC421 (81348)	1
6150-00-378-2053	CORD, LIGHT EXTENSION 17C35079-33 (19204)	1
2540-00-477-3635	COVER, AMMUNITION 11634059 (19207)	1
1015-00-678-9666	COVER, MUZZLE 8766037 (19206)	1
2540-00-767-3147	COVER, PROTECTIVE, ENGINE 10865823 (19207)	1
5120-00-240-6040	CROWBAR, GGG-B-101, Type 2, class 1, size 2 (81348)	1
5110-00-595-8229	CUTTER, WIRE ROPE, hand operated MIL-C-386 (81349)	1

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ITEMS TROOP INSTALLED OR AUTHORIZED LIST – CONTINUED

National Stock Number	Description	Qty Auth
5120-00-227-8074	EXTENSION, SOCKET WRENCH GGG-W-641 (81348)	1
6230-00-264-8261	FLASHLIGHT MIL-F-3747 (81349)	2
5120-00-061-8546	HAMMER, HAND GGG-H-86 (81348)	1
5120-00-900-6095	HAMMER, HAND, SLEDGE GGG-H-86 (81348)	1
5120-00-903-8555	HAMMER, SOFT FACED GGG-H-33 (81348)	1
5120-00-288-6574	HANDLE, MATTOCK–PICK NNH0093 (81348)	1
5120-00-230-6364	HANDLE, SOCKET WRENCH, ½ sq, 13 lg GGG-W-641 (81348)	1
5120-00-236-7590	HANDLE, SOCKET WRENCH, ½ sq, 18 lg GGG-W-641 (81348)	1
1005-00-402-2200	HEAD, BELL RAMMER, staff cleaning 8766006 (19206)	1
5120-00-224-2504	KEY, SOCKET HEADSCREW, 5/64 GGG-K-00275 (81348)	1
5130-00-889-2162	KEY, SOCKETHEAD SCREW, 7/64 GGG-K-00275 (81348)	1
5120-00-243-2395	MATTOCK, GGG-H-506 (81348)	1
4930-00-262-8868	OILER, HAND N493020 (42397)	1
8345-00-174-6865	PANEL MARKER MIL-P-40061, AMEND 1 (81349)	2
5120-00-239-8251	PLIERS, LINEMAN'S GGG-P-471, Type 9, class 1, style A, (81348)	1

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ITEMS TROOP INSTALLED OR AUTHORIZED LIST – CONTINUED

National Stock Number	Description	Qty Auth
5120-00-223-7397	PLIERS, SLIP JOINT GGG-P-00471 (81348)	1.
5120-00-624-8065	PLIERS, SLIP JOINT AT508K (00784)	1
5120-00-293-3169	SCREWDRIVER, FLAT TIP, GGG-S-121, Type 1, class 4, style 1, shape A (81348)	1
1005-00-709-7668	SECTION ASSEMBLY, BRUSH 8766014 (19204)	3
1015-00-790-3611	SECTION END, CLEANING STAFF 8766008 (19206)	1
5120-00-293-3336	SHOVEL, HAND GGG-S-326, Type 4, class A, style 1 (81348)	1
5120-00-189-7932	SOCKET, SOCKET WRENCH, 9/16 GGG-W-641 (81348)	1
5120-00-189-7946	SOCKET, SOCKET WRENCH, 5/8 GGG-W-641 (81348)	1
5120-00-235-5870	SOCKET, SOCKET WRENCH, 11/16 GGG-W-641 (81348)	1
5120-00-189-7985	SOCKET, SOCKET WRENCH, 3/4 GGG-W-641 (81348)	1
5120-00-189-7934	SOCKET, SOCKET WRENCH, 7/8 GGG-W-641 (81348)	1
5120-00-189-7935	SOCKET, SOCKET WRENCH, 15/16 GGG-W-641 (81348)	1
5120-00-189-7927	SOCKET, SOCKET WRENCH, 1 GGG-W-641 (81348)	1
5120-00-189-7913	SOCKET, SOCKET WRENCH, 1-1/16 GGG-W-641 (81348)	1

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ITEMS TROOP INSTALLED OR AUTHORIZED LIST – CONTINUED

National Stock Number	Description	Qty Auth
5120-00-189-7917	SOCKET, SOCKET WRENCH, 1-1/4 GGG-W-641 (81348)	1
7240-00-177-6154	SPOUT, CAN, FLEXIBLE 838A7511 (09647)	1
1010-00-832-9153	STAFF, CLEANING, HANDLE 11687054 (19204)	1
8340-00-817-2126	TARPAULIN KP146 (81349)	1
5120-00-224-3141	WRENCH, BOX, 5/8 - 11/16 GGG-W-636 (81348)	1
5120-00-224-3154	WRENCH, BOX, 1/2 - 9/16 GGG-W-636 (81348)	1
5120-00-187-7126	WRENCH, OPEN END, 9/16 - 5/8 GGG-W-636 (81348)	1
5120-00-240-5609	WRENCH, OPEN END, 3/4 - 7/8 GGG-W-636 (81348)	1
5120-00-277-2342	WRENCH, OPEN END, 3/8 - 7/16 GGG-W-636 (81348)	1
5120-00-277-7025	WRENCH, OPEN END, 15/16 - 1 GGG-W-636 (81348)	1
5120-00-277-8300	WRENCH, OPEN END, 11/16 - 13/16 GGG-W-636 (81348)	1
5120-00-264-3796	WRENCH, OPEN END, ADJUSTABLE, 12 inch GGG-W-631 (81348)	1
5120-00-294-9505	WRENCH, TORQUE, 100 to 750 in lb GGG-W-00686 (81348)	1

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APPENDIX C
EXPENDABLE AND CONSUMABLE OPERATING SUPPLIES LIST

Section I. INTRODUCTION

C-1. This appendix lists expendable and consumable operating supplies required by the crew to operate and maintain the M163.

C-2. Explanation of Columns. The following provides an explanation of columns in the tabular listings:

a. National Stock Number. Indicates the national stock number assigned to the item and will be used for requisitioning purposes.

b. Description. Indicates the federal item name and a minimum description required to identify the item. The last line indicates the reference number followed by the applicable Federal Supply Code for Manufacturer (FSCM) in parentheses.

Section II. EXPENDABLE AND CONSUMABLE OPERATING SUPPLIES LIST

National Stock Number	Description
	EXPENDABLE EQUIPMENT
6135-00-120-1020	BATTERY, DRY, 1.5V (Telephone) MIL-B-18, Type BA-30 (81349)
6240-00-892-4420	LAMP, GLOW (RF power indicator) MS25252 – NE2D (96906)
6240-00-763-7744	LAMP, INCANDESCENT (Ready-to-fire) MS18209-387 (96906)

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EXPENDABLE AND CONSUMABLE OPERATING SUPPLIES LIST – CONTINUED

National Stock Number	Description
6240-00-155-8707	LAMP, INCANDESCENT (Unit 2 high voltage overload and modulator overload) MS25231-313 (96906)
6240-00-155-7836	LAMP, INCANDESCENT (Unit 2 inside cover; control assembly) MS25237-327 (96906)
6240-00-997-4559	LAMP, INCANDESCENT (M61 sight reticle) 10545002 (19200)
	CONSUMABLE SUPPLIES
	DIESEL FUEL, grade DF-1, winter VV-F-800 (81348) – use above -10°F
9140-00-286-5286	bulk
9140-00-286-5287	5 gal drum
9140-00-286-5288	55 gal drum, 16 gage
9140-00-286-5289	55 gal drum, 18 gage
	DIESEL FUEL, grade DF-2, regular VV-F-800 (81348) – use above +32°F
9140-00-286-5294	bulk
9140-00-286-5295	5 gal drum.
9140-00-286-5296	55 gal drum, 16 gage
9140-00-286-5297	55 gal drum, 18 gage
	DIESEL FUEL, grade DF-A, arctic VV-F-800 (81348) – use in all temperatures
9140-00-286-5283	bulk
9140-00-286-5282	5 gal drum
9140-00-286-5284	55 gal drum, 16 gage
9140-00-286-5285	55 gal drum, 18 gage
	DIESEL FUEL, CITE MIL-F-46005 (81349) - use in all temperatures
9130-00-967-6999	55 gal. drum, 18 gage
9130-00-967-7000	bulk
9130-00-967-7002	55 gal. drum, 18 gage
9130-00-967-7003	bulk

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EXPENDABLE AND CONSUMABLE OPERATING SUPPLIES LIST – CONTINUED

National Stock Number	Description
	JP-5, Aircraft Turbine Engine MIL-T-5624 (81349) - emergencies above – 40°F
9130-00-273-2379	bulk
9130-00-285-1294	55 gal drum
	GREASE, AUTOMOTIVE and ARTILLERY, GAA MIL-G-10924 (81349)
9150-00-190-0905	5 lb can
	GREASE, INSTRUMENT AIRCRAFT, GIA MIL-G-23827 (81349)
9150-00-985-7245	8 oz. tube
	HYDRAULIC FLUID, petroleum base, OHA MIL-H-5606
9150-00-935-9807	1 qt can
9150-00-935-9808	1 gal. can
9150-00-935-9809	5 gal. pail
9150-00-935-9810	55 gal. drum
	LUBRICANT, SOLID FILM, SFD
9150-00-142-9309	12 oz can MIL-L-46147 (19204)
9150-00-834-5608	1 pt can MIL-L-8937 (81349)
	LUBRICANT, WEAPONS - SEMI FLUID, LSA-T MIL-L-46150 (81349)
9150-00-949-0323	8 oz tube
	LUBRICATING OIL, CHAIN VV-L-751 (81348) CW-11A-light
9150-00-234-5197	5 lb can
9150-00-261-7891	35 lb pail
9150-00-530-7293	120 lb drum

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EXPENDABLE AND CONSUMABLE OPERATING SUPPLIES LIST – CONTINUED

National Stock Number	Description
	CW-11B - medium
9150-00-234-5199	5 lb can
9150-00-246-3276	35 lb pail
9150-00-530-7371	120 lb drum
	LUBRICATING OIL, GEAR, sub zero, GOS MIL-L-10324 (81349)
9150-00-261-7904	1 qt can
9150-00-257-5440	5 gal. pail
9150-00-257-5443	55 gal drum
	LUBRICATING OIL, general purpose, preservative, PLS VV–L-800 (81348)
9150-00-231-6689	1 qt can
	LUBRICATING OIL, internal combustion engine OE/HDO-10, MIL-L-2104 (81349)
9150-00-111-3199	5 gal pail
9150-00-111-3200	55 gal drum
	OE/HDO-30, MIL-L-2104 (81349)
9150-00-111-0209	5 gal pail
9150-00-111-0210	55 gal drum
	LUBRICATING OIL, internal combustion engine, subzero, OES, MIL-L-10295 (81349)
9150-00-242-7603	5 gal drum
9150-00-242-7604	55 gal drum
	LUBRICATING OIL, preservative, medium, PL-M MIL-L-3150 (81348)
9150-00-231-2361	1 qt can
	LUBRICATING OIL, semifluid, automatic weapons, LSA, MIL-L-46000 (81349)
9150-00-889-3522	4 oz bottle
	SOLVENT, DRY CLEANING, SD-2 P-D-680 (81349)
6850-00-597-9765	1 gal. can
6850-00-274-5421	5 gal can

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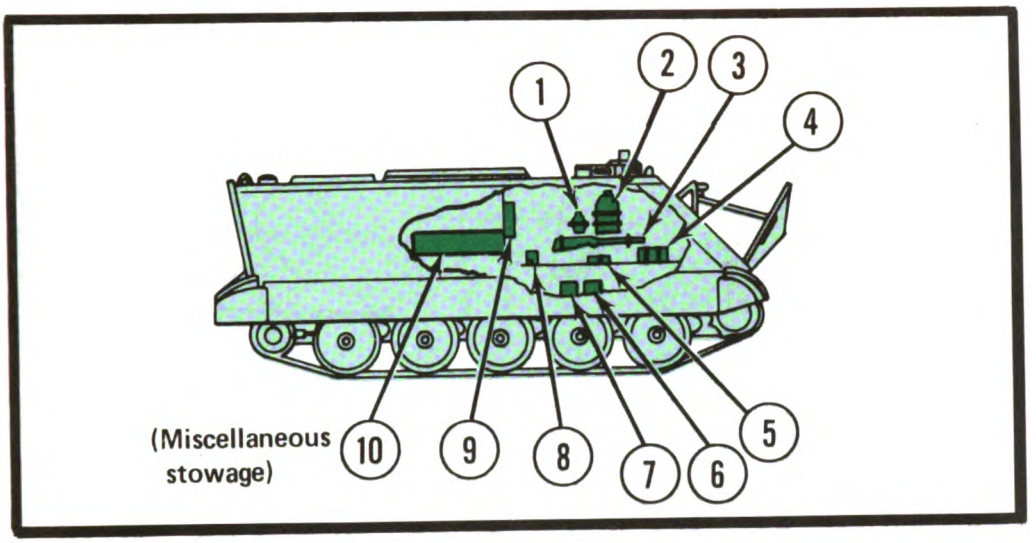
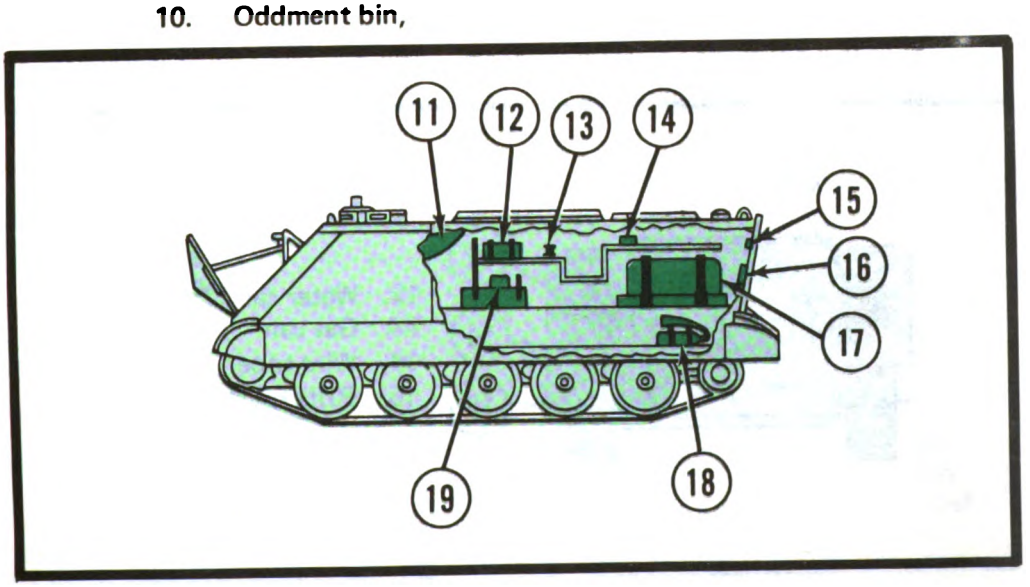
APPENDIX D

STOWED ITEMS — LOCATIONAL INDEX



1. Canteen
2. M19 periscope
3. Rifle
4. Rifle ammunition
5. First aid kit
6. M19 periscope head
7. M17 periscope head
8. Flashlight
9. Pamphlet bag
10. Oddment bin,
11. Air grille curtain
12. AN/TVS-2B sight
13. Muzzle clamp
14. M134 telescope
15. Flashlight
16. External range control
17. Generator (APU)
18. Fire extinguisher
19. Tool bag



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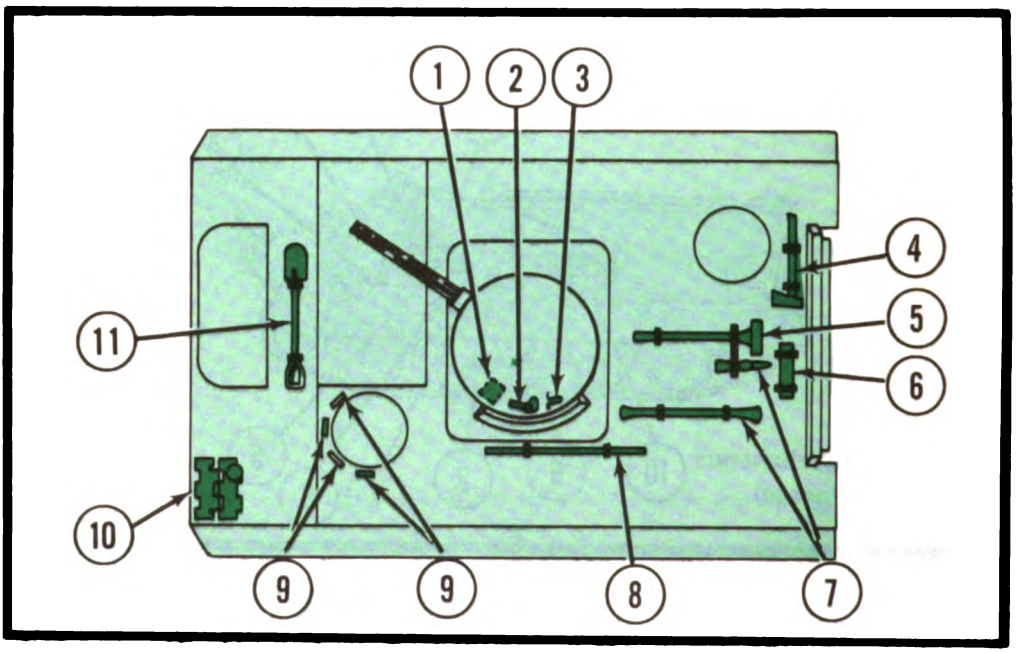
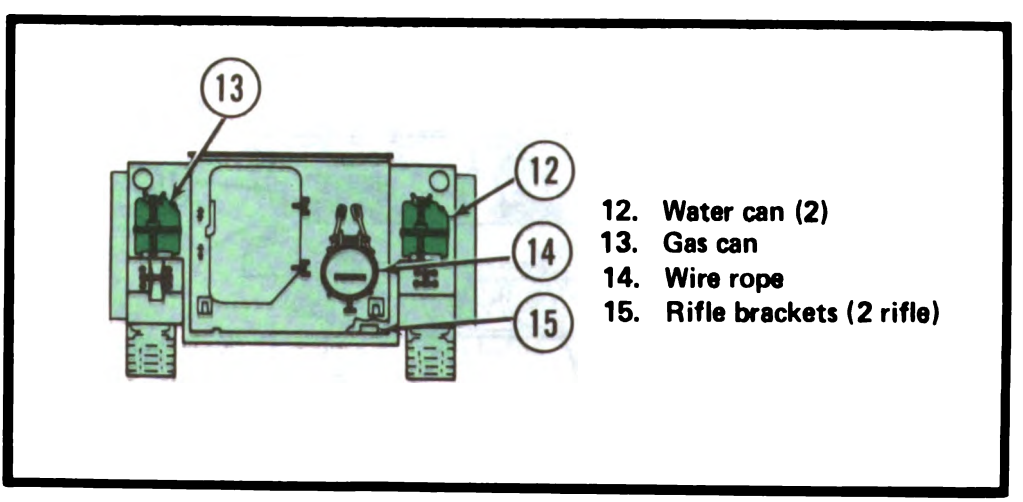


1. Rifle ammunition pocket (2)
2. Fire control quadrant
3. Rifle
4. Axe
5. Hand hammer
6. Track connecting fixture
7. Mattock
8. Crow bar
9. M17 periscope (4)
10. Track shoe (2)
11. Hand shovel



12. Water can (2)
13. Gas can
14. Wire rope
15. Rifle brackets (2 rifle)

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